JUL 11 1921

Electrical World

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Electrical World

New York, Saturday, July 9, 1921

The Confusing Variety of Electrical Men

WE ARE making progress in this world of ours. We are doing better in our industry. We are gradually, collectively developing more common sense and using it.

The other day the Electrical Supply Jobbers' Association elected a representative to sit hereafter on the executive committee of the National Electric Light Association. There are already members representing the electrical manufacturers. Some day we shall probably see a member representing contractor-dealers. The result will be that problems of the electric light and power company coming before this body can have the consideration, the advice and the support of all the other major branches of the industry. They can be treated as matters primarily concerning the electrical business in its fullness. For, after all, it is the electrical business that we are all working in and for—not power plants or factories.

There have been too many kinds of electrical men. The manufacturer, the jobber, the central-station man and the contractor-dealer have all maintained their independent contact with the public. Each has endeavored to sell himself and his own service, working from his own little corner and expressing his own class point of view. But it has not meant much to William Jones.

William Jones and all the other people look upon us as just "electrical men" in the "electrical business." They know that it is a fine business, a big business, a growing business. But they think and care about as much concerning the inner workings of our industry as the average electrical man thinks and cares about the inside politics of the hardware world. People do not want to be confused with our cross-talk. They are interested simply in what the electrical business has to sell to them and in being well served.

Anything and everything that we among ourselves can do, therefore, to standardize our product and to harmonize our purposes and policies is a big help to the electrical business. It makes it easier for the rest of the world to understand us, to believe us, to take our advice and buy our goods. And that's the vital thing. All the doings within our industry are just our family affairs.

Every man of us should be continually conscious of this personal responsibility to the family. He should read not one but every section in the ELECTRICAL WORLD and know the electrical business broadly as Jones thinks he does. And when he makes decisions, he should reason, not just as a jobber or a contractor, but for his industry as an "electrical man."

Louis Aloysius Ferguson

One of the small group of engineers who have consistently contributed to the progress of the central-station industry since its very beginning

AS A LEADER in the engineering development and administration of the largest electric light and power company in the world Louis A. Ferguson has made for himself a prominent place in the central-station industry. His entire business and professional life has been spent in the service of the Commonwealth Edison Company and its predecessors. Early in his career he perceived the wider significance and possibilities of the ecntral-station business, and he had the capacity to grow with it. A military training in the Dorchester (Mass.) High School gave him a boyish ambition to go to West Point, but he was dissuaded from this idea and took instead the course in electrical engineering at the Massachusetts Institute of Technology, from which he was graduated in 1888. While a student there young Ferguson prepared a thesis on the "Relation of Candlepower to Current, Voltage and Energy Consumed in the Incandescent Lamp." It was the first research and analysis of its kind, and the thesis was abstracted and presented before the Society of Arts at Boston by Prof. Charles R. Cross, attracting a great deal of favorable comment.

Joining the staff of the Chicago Edison Company in August, 1888, as an engineer in the underground department, Mr. Ferguson has come up to his present position of vice-president in charge of contract, operating, construction and electrical departments through the engineering side of the company.

Mr. Ferguson, who is not yet fifty-four years old, having been born Aug. 19, 1867, has received many honors from his professional associates in recognition of his ability and his contribution to the art. He is one of the few men who have been president of three national electrical organizations, namely, the National Electric Light Association, the Association of Edison Illuminating Companies and the American Institute of Electrical Engineers. He is also credited with being the first to utilize three-phase generation and transmission in conjunction with converter substations to supply a direct-current network. He has also prepared numerous engineering papers for various national associations. In 1897 a paper presented by him before the Association of Edison Illuminating Companies on "Economy in Distribution of Electrical Energy" advocated the centralization of production, a theory that the industry has so generally adopted.

Mr. Ferguson has made a number of trips to Europe to study engineering development, the first of which, in 1896, resulted in recommendations to the Chicago Edison Company that it adopt the differential rate system now so largely employed. Following his belief that an engineer is something more than a technical expert, he has always been active in Chicago affairs.

Mr. Ferguson is a man of action, strong character and pleasing but aggressive personality. In the play of these qualities he has the deliberation which avoids mistakes and the tact which makes friends.

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Opportunities in the Copper Wire Market

THE present plight of some of the wire manufacturers arouses in our mind the suspicion that users of copper wire are not always keenly alive to their opportunities. Movements in copper are still sluggish, yet low-priced copper will soon be a thing of the past. Production is far from normal, and constant drains are being made on reserve stocks. Cotton and rubber, the other chief ingredients of insulated wire, are also low in price at present, but the world's visible supply of cotton is less than it was a year ago and exports of rubber from Brazil are only about one-third of what they were at that time. There is, of course, still a possibility of lower labor costs, but when all of the facts are taken into consideration, the trend is obvious once things begin to move. For those who can use copper wire at all we suggest a careful study of the market. While general trade in this country is at present dull, it is questionable whether such a splendid opportunity for making investments in wire will present itself again for a long time.

The Tariff on Oil Is a Tax on Industry

WE VERY much regret to note in the tariff bill laid before the House of Representatives a few days ago that it is proposed to levy a tax on crude and fuel oil. Now, on general principles of a sound national policy we believe in protecting American industries, but we do not believe that protection ought to be solely for the purpose of raising the price to the consumer. The proposed tax on oil would be a straight tax on American industry from which none would gain benefit save those who might be thereby enabled to start a corner in oil and still further burden the plants requiring it for fuel. It is not as if the United States produced, all told, enough oil to satisfy the actual requirements of its citizens. On the contrary, there is a serious shortage, and for several years past the country has been obliged to import oil, not in competition with the native oil producers, but to make up for the shortage which he cannot, or at least does not, meet. The only effect of imposing a duty upon the oil, then, will be artificially to create a shortage to enhance the profits of the producers at the expense of all industries that use oil fuel, and to the serious punishment of enterprising Americans who, realizing that the production of the country is insufficient to meet its needs, have taken stiff risks in the development of foreign fields.

Electric light and power companies and all other fuel-using industries have been hard pushed in the matter of coal supply by devious practices which the government seems impotent to check. The present proposition to punish those who attempt to escape from the clutches of the coal profiteers by the use of oil is foolish to the verge of criminality. Protecting American industry against the dumping of foreign goods is a wise and proper step, but it is difficult to find words of condemnation strong enough to fit the requirements of a proposition to levy taxes upon articles of necessity which this country supplies in amounts actually insufficient to meet the normal demands of the people. Grave injustice is done to the consumer by thus creating artificially a shortage in a necessary commodity.

Central-Station-Company Advertising Often Too Dignified—The Reason

IT HAS been said that electric light and power company advertising is, much of it, too dignified. And this is true. It is a matter that deserves a little thought and some attention, for every dollar of stockholders' money spent in advertising should have every possible opportunity to bring profitable results either in good will or in sales. The trouble is that the activity of most light and power companies is too often criticised and approved by an executive whose thoughts are more of engineering than of publicity. Unconsciously his preferences in diction will express themselves. Yet, though dignity is admirable, though pure classic English is commendable, still the purpose is often not to express a literary style, but to interest many average human beings and to make them think. And even as we pick our words in conversation to suit the man we are talking to, so must we do in advertising. We must talk the language of the many. We must be simple, lucid and above all human, for we must arouse attention and awaken interest before we can hope to influence. All this can be done without the slightest bad taste either in expression or display.

The best way to test advertising matter from this point of view is to compare it with the advertising of a variety of other successful concerns in different lines of business. Their lead may be worth following if they have proved by their prosperity that they know how.

Water-Power Development on the St. Lawrence River

THE American and Canadian commissioners on the St. Lawrence-Lakes-to-Sea. Waterway have submitted their report, on which a large staff of American and Canadian engineers have labored for more than a year and a half. Although the work of the commissioners was primarily devoted to the question of providing a deep waterway from Lake Ontario to Montreal so that oceangoing steamships might navigate from as far west as Duluth, Milwaukee and Chicago to the Atlantic Ocean, incidental to the scheme there are vast

water-power projects aggregating 1,750,000 hp. It is estimated that the deep waterway can be built for approximately $250,000,000, this cost to be divided between the United States and Canada, and that the water power would pay for the entire project within a reasonable time. Whether canalization would ever bring about navigation by oceangoing vessels from the ocean to the head of the Great Lakes only time can determine. There are still sites on the St. Lawrence River readily capable of economic development. Such difficulties as are encountered have to do with ice more than anything else, and even the ice troubles on the St. Lawrence, formidable as they are, can be mastered. Arthur V. White, consulting engineer of the Commission of Conservation at Ottawa, Ontario, has estimated the low-water power of the international portion of the St. Lawrence River at about 800,000 hp., of which Canada is entitled to one-half, and the potential low-water power on the portion of the river which lies wholly within the Dominion of Canada at 1,400,000 hp. Thus Canada stands to gain more than the United States through deep-waterway development, so far as water power is concerned; and the financial condition of the Dominion is such as to make it questionable whether at this time she would be willing to join with the United States in the further canalization of the St. Lawrence. It is in the United States where the power is mostly needed, and if some means can be provided whereby the St. Lawrence may be developed by private capital and in keeping with the plans of the joint commission, navigation might be improved in spots and hydro-electric energy made available sooner. If none of the numerous sites can be developed until the project as a whole is completed, electricity from the St. Lawrence will be a long while in coming.

Formulas for Heat Losses in Armature Conductors of Alternating-Current Machines

IT IS only in recent years that attention has been called to certain peculiar extra-resistance effects in the armature windings of alternating-current machines. At the recent A. I. E. E. convention, however, Prof. W. V. Lyon contributed a valuable paper on the subject. He is able to derive short, compact and powerful formulas by resorting to complex hyperbolic angles. The complex angle bids fair to be as powerful a tool as the complex number in alternating-current engineering computations. Without the use of these complex angles Professor Lyons' results would be unreadably unwieldy and complicated.

The effective working resistance of alternating-current armatures is in some instances several times the stationary cool resistance. The greater part of the increase is usually caused by a redistribution of the current density over the cross-sections of the conductors, due to alternating magnetic fluxes across the slots. The current density tends in general to crowd to the outer surfaces of the conductors, near the tops of the slots, and to empty the lower surfaces, near the bottoms of the slots. This change of current density always means more heat loss and more effective resistance. Uniform current density over the conductor cross-sections invariably reduces, in other words, the heat loss I^2R to a minimum. This is essentially the same type of phenomenon as produces skin effect in a rod or cable carrying alternating currents or edge effect in a conducting strap. The internal oscillation of magnetic flux in the conductors sets up alternating electromotive forces which disturb the distribution of current density. The computation of the extra losses due to skin effect or edge effect in aërial conductors is complicated by the geometrical complexity of the magnetic flux paths. As a general rule the problems cannot be solved in the present state of engineering mathematics. In the case of armature conductors embedded in rectangular slots there is a simplification in one direction, that the magnetic flux paths are assumed to lie in parallel straight lines, all at right angles to the walls of the slot. On the other hand, the subdivision and transposition of the slot conductors, taken together with the nonferric end connections, make for more complexity.

Keep Your Load Factor in Focus

POWER-PLANT operation analysis demands extra care wherever more than one type of prime mover is involved in the supply of energy to the buses. In a "simple" steam plant or in a water-power station *per se* little difficulty arises in attempting to interpret the relations between outputs and costs, loads and performance. The plot thickens, however, with interconnection. Clear thinking is necessary in order not to confuse the different load factors, outputs, peaks and plant services in judging the efficiency of individual stations tied in with others. If the exact sort of load factor meant in such analyses is not kept sharply in mind and if necessary repeated in conversation and written records and communications, false ideas as to how different stations are functioning may easily creep in. Due allowance must be made for purchased energy, for local peak loads and for system peaks and interchanges if sound conclusions are to be drawn. Owing to the purchase of secondary power, for instance, the peak load at a local plant in a particular district may run high in relation to its steam generating capacity, and in judging the station performance its own output and production must be separated from the district peak and kilowatt-hour readings. Accurate work pays here as elsewhere.

Theory of Probabilities Applied to Electron Behavior

AN EXCELLENT summary of the latest results of researches in radioactivity, including Millikan's determination of e, the electronic charge, has been presented by Sir Ernest Rutherford in a series of lectures which he recently delivered in London. A remarkable aid in some of these investigations has been the theory of probabilities. The groupings, in time, of successive electronic impacts on a charged conductor and the groupings, in space, of electronic reflections from an atomic structure appear at first sight as heterogeneous and erratic associations until analyzed in the light of crowd behavior or the theory of probabilities. It then appears that these groupings are rationally erratic, and their apparent inconsistencies come to form valuable evidence.

The most recent evidence obtained in this way suggests that an atom of matter may well be a microcosmic sun-and-planet system in which the positive electrons, condensed at the center, form the sun and the separate negative electrons the planets. The negative-electron planets revolve in orbits of diameters that are large relative to the diameter of the positive nucleus around which they move. Foreign positive electrons

coming into such a planetary system are likely to be repelled by its positive nucleus, and the path of the invading electron appears to be a plane hyperbola.

When a satellite mass invades our solar system it is able to move off in a path which may be elliptical, parabolic or hyperbolic, according to the velocity of the invader and to the geometry of the system. In the case of a positive electron invading a microcosmic atomic system the ellipse seems to be ruled out of possibility, the hyperbola becoming the standard form of trajectory, with the parabola as a limiting case.

Saving Time and Brains in the Coil-Winding Shop

THERE is probably no greater chance for waste of time and energy than in the plant where motor coils are wound and all construction details must be explained to the workmen by the foreman. Because of their nature these instructions must be written, and they should be in such form that they can be handed successively to all workmen engaged in making the coils. A system which meets these requirements and minimizes the amount of writing which must be done by the foreman is described in this issue by A. C. Roe. The article also explains how to keep information on the construction of different types of coils which must be made permanently available to the man who specifies the kind of coil and insulation that must be used. Being kept on permanent file, the cards serve as a convenient reference in writing specifications for coils which duplicate some made before. This is no small advantage, since many jobs in a winding shop are repetitions of former work.

California Gets Maximum from Hydro-Electric Developments

MUCH has been written of the advantages of interconnection of power companies and the creation of superpower zones for the best utilization of natural resources, whether these be coal mines or water powers. A valuable example of such interconnection on a large scale has been worked out in California. Here a scheme of operation was formulated during the war by which energy could be interchanged between systems to insure against the wasting of water in by-passing hydro-electric plants when plants in other systems were burning oil. Oil had been in great demand for war purposes and oil prices had risen accordingly. Interconnections were made, therefore, under the direction of a state power administrator, to handle sufficient energy to insure the maximum use of hydro-electric plants, and the scheme worked out so well that it was continued after the war. In this issue F. B. Lewis gives an excellent account of the practical working of this power administration.

In California, where hydro-electric development plays such an important part in the economic life of the community, the load characteristics are also favorable to the use of water power, since heavy loads occur in the summer as well as in the winter. In fact, the irrigation load in the summer reaches a higher peak than combined lighting and industrial loads reach in the winter. It was possible, by the creation of a central authority and a careful study of all loads, to operate the combined systems to prevent wasting water in one system when a demand for hydro-electric energy existed in a neighboring system. This centralized management of power resources has worked out splendidly in California, and Mr. Lewis shows how the base load is carried by new and highly efficient hydro-electric stations. As the load comes on during the day other hydro-electric plants are put on the system, until finally short-time peaks are carried by steam plants, the least efficient ones being added as a last resort.

Under this plan a most careful water-storage program can be worked out to insure the use of modern hydro-electric plants on the base load. Account must also be taken of the fact that in some cases only limited storage exists and these stations must be used when the water is available.

The experience in California and elsewhere shows that there should be no difficulty in the matter of settlement for energy interchanged. The existence of different voltages or even different frequencies proves no obstacle to interconnection. The maximum use of water resources is sound policy both from the point of view of the central-station company and from broad national considerations.

Wood Poles Have Been Found Suitable Even for Lines of Extra-High Voltage

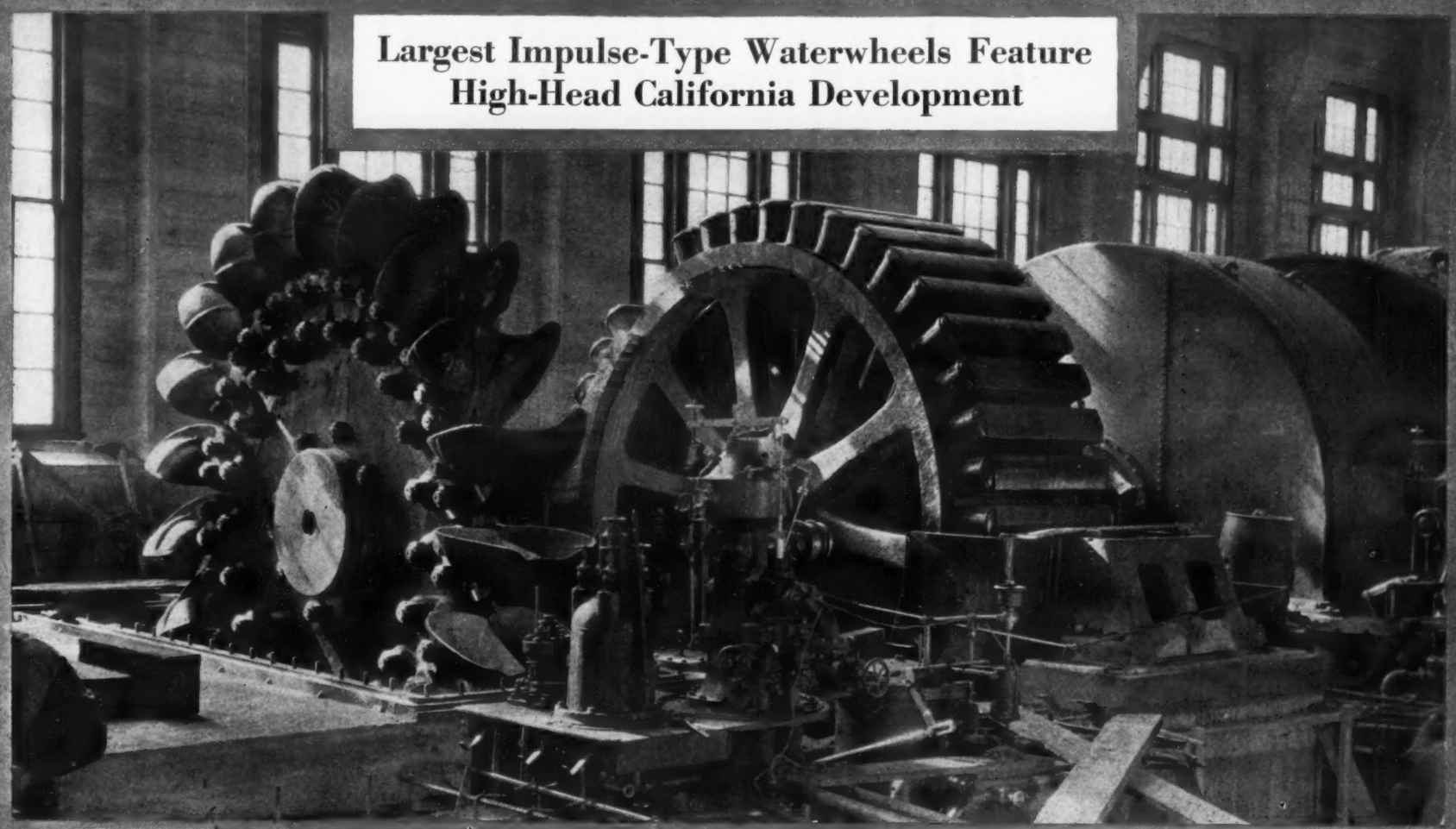
OWING to the difficulty of obtaining steel during the war, some electric service companies employed wood poles even for lines of the highest voltage. The experience gained indicates that it is still worth while under certain conditions to consider such construction for high-voltage lines. This phase of the subject, together with comparisons of costs for steel and wood lines and forms of construction which have been found desirable, is discussed in the article by J. A. Sirnit beginning on page 59 of this issue.

In line construction more than the first expense and yearly upkeep must be taken into consideration. If interruption of service over the line would involve great financial loss to the consumers or operating company, and if the line is subjected to severe climatic conditions, steel tower lines may be preferable, although wood-pole line construction has given excellent service in Montana, for example. If no serious wind, snow or sleet storms prevail in the vicinity of the line, service over wood-pole lines can be made as secure as with other construction.

The duration of the load and the prospects of its growth are dominating factors in any choice between wood and steel. If the load is known to be temporary and there is no certainty that other business may be developed along the line, then steel construction may hardly be justified. However, one should be careful to distinguish between a line extended through sparsely settled territory for a temporary load and one built through fast-growing country to serve the same load.

While serious difficulty is experienced in financing lines, initial cost may be more important than yearly operating expense. Under ordinary conditions, however, the annual charges should have first consideration in any comparison of wood and steel construction. Replacement of poles is also an important consideration, because it may be a very expensive operation. In comparing the annual charges on wood and steel, special attention should be given to the kind of soil in which the line supports are set, since in some places wood poles might without butt impregnation remain for an unusually long period, whereas in other places impregnation is almost imperative if any reasonable pole life is to be expected. In this connection, too, it must not be forgotten that the effect of galvanizing on the permanency of steel towers is not always the same. There is galvanizing and galvanizing.

Largest Impulse-Type Waterwheels Feature High-Head California Development



ANOTHER record in prime-mover design has been broken in the new impulse-type waterwheels placed in operation in the Caribou station of the Great Western Power Company, in California. Two units are now in service, each consisting of a 22,223-kva. General Electric revolving-field generator directly driven by two overhung Allis-Chalmers impulse wheels with a combined rating of 30,000 hp. Six sets will compose the ultimate installation. The plant will operate under a head of 1,008 ft. and will constitute the largest and most important station to be built in bringing about the comprehensive utilization of the Feather River. Stone & Webster, Inc., are the designers and builders.

Power Administration Effects Economy

Methods Which Have Been Adopted in California to Operate Steam and Hydro-Electric Plants for Maximum Efficiency and Economy of Resources—General Interconnection Between Various Companies Makes This Possible

By FRED B. LEWIS
Assistant Manager of Operation Southern California Edison Company

OWING to the difficulties experienced in obtaining money and materials, the development of generating facilities during the war had to be delayed by most operating companies in California. As a result an acute power shortage was experienced throughout California in 1920. To offset this companies in the northern and southern halves of the state were interconnected so that the utmost use could be made of all available equipment. This arrangement has been in force long enough for two marked benefits to be observed. One is that the character of the load curves of the companies differed to a degree that permitted considerable benefit to be experienced from the demands. The other—and very important—benefit is the possibility of making use of the energy which costs the least to produce and of substituting the greatest possible amount of hydro-electric for steam generation. In other words, the interconnected group can be operated exactly as a well-managed individual system should be—*i.e.*, for the least possible cost consistent with good service and to insure the maximum conservation of fuel.

INTERCHANGE BETWEEN SYSTEMS WITH DIFFERENT FREQUENCIES

Two methods of settling for energy interchanged between companies are employed: A company purchasing in order to meet the demands upon its system pays the selling company the actual out-of-pocket cost at the point of metering plus 15 per cent. If the interchange is made because one company can afford to sell cheaper than the other company can produce the energy, then the price is determined by splitting the saving effected.

In the southern half of the state there are seven systems interconnected, the largest and most extensive in territory being that of the Southern California Edison Company. In this group two frequencies are standard, 50 cycles and 60 cycles, necessitating frequency changers at some points of interconnection. In one instance, where a frequency changer is not at hand, exchange of 3,000 kw. is handled by operating nominally rated 50-cycle motor-generator sets on 60-cycle energy, allowing the direct-current generators to remain in parallel with those operating on the 50-cycle energy. In this way the shifting is accomplished without interruption of service.

The total territory covered by the interconnected companies is approximately 350 miles (560 km.) north and south by 150 miles (240 km.) east and west, and the maximum demand of the combined load is about 300,000 kw., which occurs in the forenoon during the month of July, on account of the heavy demand of the agricultural load. In addition, the daily load factor is greater in the summer, making the kilowatt-hour demand heaviest at that time. The winter load has an evening peak only slightly less than that of the summer, but the daily load factor is materially less.

The schematic chart (Fig. 3) illustrates a typical 1920

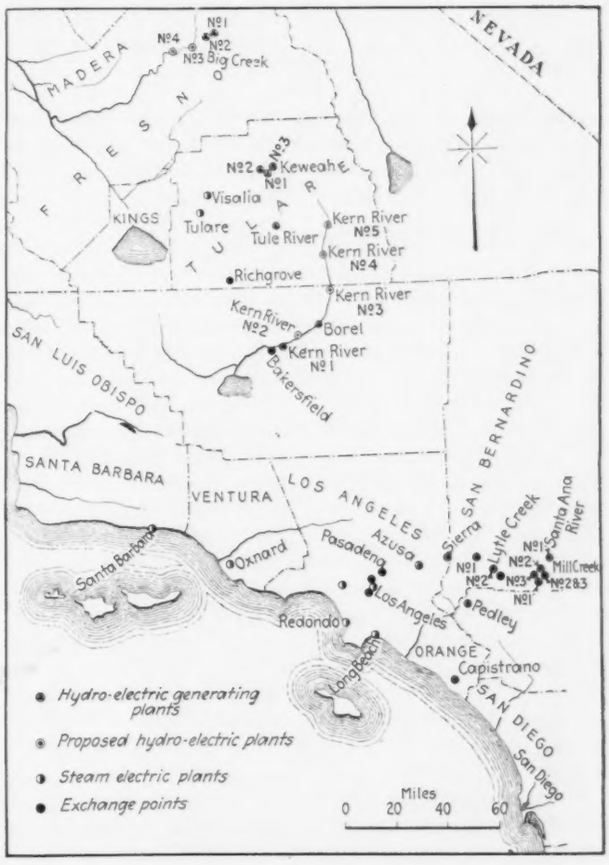


FIG. 1—SEVEN SYSTEMS INTERCONNECTED FOR POOLING ENERGY RESOURCES IN SOUTHERN CALIFORNIA

summer-day load curve of the Southern California Edison Company, together with the sources of power that were utilized. These sources, of capacities noted, are operated in the order of their cost factor, as is shown. It will be noted that the more expensive sources of energy, whether on the Edison system or another, are used for the shortest period of time on the peaks, and that the cheaper energy is used throughout the greater possible period. Naturally the order of operation changes with a change in the price of fuel and other items that go to make up the cost factor. This factor is the increment cost over and above fixed standby cost determined, by including losses, at the point on the system to which the energy must be transmitted. This is equivalent to the amount that is saved when the particular source is not required.

During the year 1921 it will not be necessary to operate plants or utilize energy from interconnected companies having cost factors greater than the Redondo steam plant of the Southern California Edison Company, for the reason that considerable additional hydro-

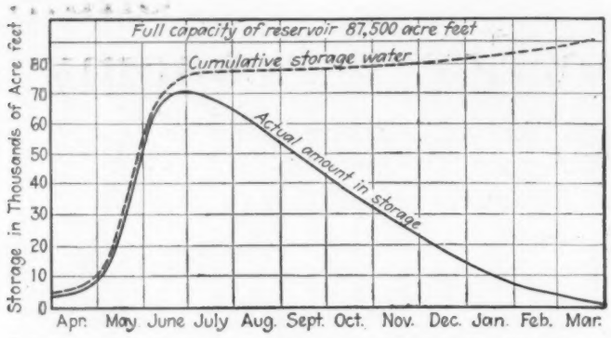

Full capacity of reservoir 87,500 acre feet
Cumulative storage water
Actual amount in storage
Storage in Thousands of Acre feet
Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar.

FIG. 2—WITHDRAWAL SCHEDULE FOR HUNTINGTON LAKE RESERVOIR. SOLID LINE SHOWS HOW MUCH IS AVAILABLE

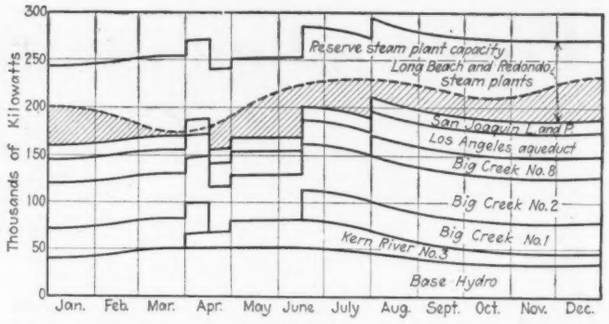

Reserve steam plant capacity
Long Beach and Redondo steam plants
San Joaquin L. and P.
Los Angeles aqueduct
Big Creek No. 8
Big Creek No. 2
Big Creek No. 1
Kern River No. 3
Base Hydro
Thousands of Kilowatts
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 4—PROBABLE PEAK DEMANDS (DOTTED) AND USE OF POWER RESOURCES, SOUTHERN CALIFORNIA EDISON COMPANY IN 1921

electric capacity has been developed by the companies since the interconnection. The Southern California Edison Company alone has added 48,000 kw., and by August another 22,500 kw. will be added.

USE OF STORED WATER IN ESSENTIAL PLANTS

The Huntington Lake withdrawal schedule for 1920-21 (Fig. 2) illustrates by a dotted line the accumulative, and by a solid line the actual, amount of storage water during the fiscal year from April 1 to April 1, the run-off beginning usually during April. As soon as the maximum storage is determined, which is usually possible during June, the withdrawal schedule is predetermined for the season. In doing this consideration is given to the fact that the plants operated from this storage water are absolutely essential for peak capacity throughout the year, that only a certain amount of water can be used per month on account of the load absorption, the minimum amount to which it is safe to withdraw in view of the uncertainty as to the exact time of run-off, and the desirability of maximum withdrawal during periods of increased fuel costs. It will be noted that the rate of withdrawal is greater during the summer months than during the winter months, which is due to the better load factor, this in turn permitting greater load absorption.

In actual operation base-hydro, or stream-flow, plants are operated to the utmost capacity obtainable from water available. Likewise steam plants are operated on block loads so as to obtain maximum economy, for, as is well known, fractional loads or variable loads on steam units are attended by serious losses. Therefore the regulating is done with storage-hydro plants, and the operation of steam units is "blocked out" or scheduled so as to obtain the lake withdrawal desired.

In the operation of steam-turbine units, if maximum economy and reliability are to be obtained, it is imperative that allowance be made for periodic inspection, overhauling and perhaps reblading. In order to predetermine the overhauling program for all units, knowledge of the peak demand and of available capacity throughout the year is necessary. The amount of steam capacity required for the system of the Southern California Edison Company during the present year is shown in Fig. 4. This takes into account the variation of base-hydro plant capacity due to the seasonal variation of stream flow, the influence that certain run-off conditions have upon storage-hydro capacity, and also the additional capacities due to the completion of new water-power plants. For this system it clearly shows that the best time of the year for turbine overhauling is from Jan. 1 to June 1. Likewise repairs to base-hydro units or to tunnels, flume lines, etc., in connection therewith are scheduled for the season of minimum water.

On systems where the base-hydro capacity exceeds the load demand during certain hours of the day or during certain seasons of the year interconnection with steam-operated systems is most desirable in order that fuel can be conserved by the substitution of water power.

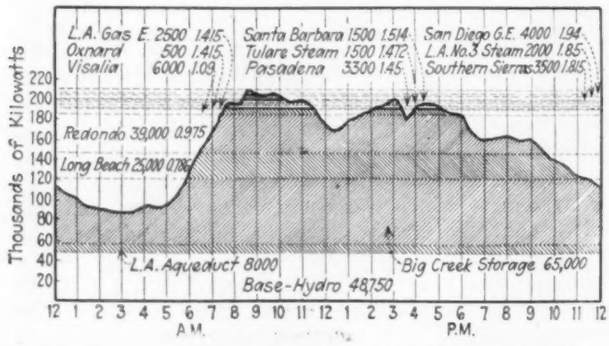

L.A. Gas E. 2500 1.415
Oxnard 500 1.415
Visalia 6000 1.09
Santa Barbara 1500 1.514
Tulare Steam 1500 1.472
Pasadena 3300 1.45
San Diego G.E. 4000 1.94
L.A. No. 3 Steam 2000 1.85
Southern Sierras 3500 1.815
Redondo 39,000 0.975
Long Beach 25,000 0.78
L.A. Aqueduct 8000
Base-Hydro 48,750
Big Creek Storage 65,000
Thousands of Kilowatts
12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
A.M. P.M.

FIG. 3—OPERATION SCHEDULE, SHOWING ECONOMICAL USE OF STATIONS FOR A TYPICAL SUMMER DAY

Hydro-Electric Progress in France

THE steady progress being made by the French Republic in the development of its hydro-electric resources, to which many references have been made in the ELECTRICAL WORLD, is referred to in a recent commercial report from the United States Vice-Consul at Lyons, who says:

"Special interest is being shown in the completion of a large hydro-electric plant of 20,000 hp. by the Société Hydro-Electric of Lyons, a branch of the Compagnie du Gas of Lyons and the Compagnie Continentale Edison of Paris, at Seyssel, Haute-Savoie. Southwest France, with its many streams and mountains, offers wonderful opportunities for development of hydro-electric power. Much progress has been made along this line in the last few years, particularly in the Department of Isere. The plant recently completed, however, is the largest one yet put in operation. A measure is now being considered by the French government for the navigation of the Rhone River above Lyons, in which provisions are considered for the utilization of the hydraulic force of this swift-flowing stream. It therefore appears to be only a question of time before the growing industries of this region will have gone a long way toward solving the perplexing fuel problem by obtaining the necessary power from hydro-electric plants. The new plant will supply about one-third of the energy required for such a city as Lyons."

Wood-Pole Structures for 110,000-Volt Transmission Lines

Factors to Be Considered in Using Wood Poles for High-Voltage Lines — Costs Vary from $3,950 to $9,600 per Mile — Details of Line Construction — Comparisons Between Wood-Pole and Steel Structures

By J. A. SIRNIT
Designing and Electrical Engineer Alabama Power Company

OWING to the necessity for rapid construction of transmission lines during the war and the scarcity and high cost of ordinary materials going into the usual steel transmission structure, the Alabama Power Company investigated the possibility of high-voltage wood-pole transmission lines very carefully. As a result of this study the first line was built for the government from Warrior to Muscle Shoals, at Sheffield, Ala., in the latter part of 1918. The results obtained from this line were quite satisfactory, but certain details of construction were improved upon in a line which was built in the latter part of 1919 as a regular part of the Alabama Power Company system. This type of line construction is being used also, and with apparently good results, by several other companies, particularly in the Northwest, where there is abundance of suitable poles and timber.

CONDITIONS WHICH JUSTIFY WOOD-POLE STRUCTURE

Before deciding to build a wood-pole tower line for voltages as high as 110,000, certain economic studies should be made comparing this with other types of construction. War conditions in 1918, were, of course, exceptional and out-weighed any other consideration at that particular time. However, in the light of experience with such lines, it can be said that certain factors may carry enough weight to justify the construction of these lines even at the present time.

The initial cost of a line as compared with other forms of construction is probably the most important consideration. However, first cost must not be considered the dominating factor in the decision. The upkeep cost which follows as the line becomes older must also be taken into account, and this may entirely outweigh the consideration of first cost. Assuming, then, that raw materials such as wood and steel are equally obtainable, the important considerations would seem to be as follows: First cost, location, type of load served, probable duration of load and probable line-maintenance cost. Geographical location of a line would have a definite bearing on the cost of a wood-pole structure as compared with steel. Considering that the life of a wood structure is not so long as that of one built of steel, the question of type of load served becomes an interesting point. That is, the load may be neither large enough to warrant nor show signs of developing to the point of warranting an expensive steel transmission line; or, as in the case of the war industries which had to be served by this line, the duration of the load may be of uncertain nature.

TABLE I—COST PER MILE OF 110,000-VOLT WOOD-POLE TRANSMISSION LINE *

Built 1919. Single-circuit, No. 1/0 aluminum steel-reinforced (No. 2 copper equivalent) conductors.

Poles and fixtures (material)		$1,678 00
Eighteen poles at $24.50 each	$441.00	
Eleven cross-arms, at $11 each	121.00	
Hardware, 1,800 lb., at 12 cents per lb.	216.00	
Insulators, 260 units, at $2.50 per unit	650.00	
Miscellaneous	50.00	
Poles and fixtures (labor)		676.00
Digging holes for eighteen poles, at $11 each	196.00	
Distributing material, 105 ton-miles, at $1.80 per ton	189.00	
Framing poles, nine towers, at $12.50 each	112.50	
Erecting poles, eighteen, at $6.40 each	116.00	
Unclassified	62.50	
Wire (material)		869.00
Conductors (No. 1/0 aluminum), 2,300 lb., at 25 cents per lb.	575.00	
Ground wire (¼-in. stranded), 3,600 lb., at 8 cents per lb.	288.00	
Splicing sleeves, etc., at $6 per mile	6.00	
Wire (labor)		217.00
Distributing material, 8 ton-miles, at $1.50 per ton	12.00	
Stringing conductors, at $105 per mile	105.00	
Stringing ground wires, at $85 per mile	85.00	
Miscellaneous	15.00	
Construction superintendence, per mile		510.00
Total construction cost, per mile		$3,950.00

* To these figures must be added engineering, right-of-way, clearing and general overhead costs; also costs of special structures, such as river crossings, to get the total costs of any particular line, as these items are dependent on local conditions, and at times may amount to as much per mile as the direct costs given above.

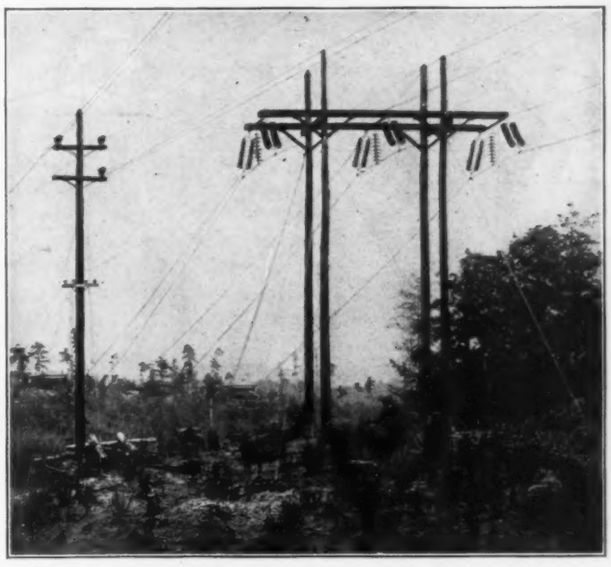


FIG. 1—FOUR-POLE, DOUBLE-ARM STRAIN TOWER FOR SPANS OVER 1,000 FT.

But even where the above-mentioned conditions would favor steel-tower line construction, the financial question should be carefully analyzed. Quite frequently it is found that it is decidedly more advantageous to build a cheaper line with wood poles at the start, even at the expense of larger maintenance and ultimate replacement costs, than to construct a steel-tower line.

The first line from the Warrior steam plant of the

Alabama Power Company to Muscle Shoals consisted of a single circuit of 250,000-circ.mil copper conductors, each supported by eight insulator units in suspension or ten units in strain. Long-leaf yellow-pine creosoted poles 50 ft. (15 m.) high were used to bring the conductors 35 ft. (10.5 m.) above the ground at the supports. Cross arms were of 6-in. x 8-in. (15-cm. x 20-cm.) creosoted long-leaf yellow pine. The direct construction cost of this line was approximately $9,600 a mile. The construction cost of a steel line of the equivalent capacity and to give the same service would probably have been $12,500 a mile.

The second line, which was 62 miles (100 km.) in length, cost $3,950 per mile, as shown in the itemized cost for a single mile of this line given in Table I. This cost is based on unit prices existing during the latter part of 1918. The general features of this line were the same as those of the line from Warrior to Muscle Shoals, the lower cost being due to smaller conductors and ground wire and also to the longer spans used on that account and the use of chestnut instead of creosoted poles. The substitution of tension rods for bow braces further helped to reduce the cost.

For the first line four main types of transmission structures were employed, namely, four-pole, double-arm strain towers, single-arm suspension-type towers, double-arm suspension-type towers and double-arm strain-type towers. In Fig. 1 is shown a four-pole, double-arm structure for spans over 1,000-ft. (300 m.) and angles under 10 deg. On longer spans with angles above 10 deg. similar construction is used but with strain insulators. The poles are 50 ft. (15 m.) in length, set 7 ft. 6 in. (2.3 m.) in ordinary ground and with a cross arm 35 ft. 4 in. (10.7 m.) above the surface. Four 6-in. x 8-in. x 29-ft. (15-cm. x 20-cm. x 8.7-m.) cross-arms are employed with bow braces made of 3-in. x ¼-in. (7.5-cm. x 6.3-cm.) angle iron. The distance between poles at right angles to the line is 14 ft. (4.2 m.), and the distance between poles parallel with the line in the structure is 10 ft. (3 m.). The cross braces at the poles are 6-in. x 8-in. long-leaf yellow pine, while the small cross braces shown in the photograph are 3-in. x $\frac{5}{16}$-in. (7.5-cm. x 7.9-mm.) angle iron. The particular tower is known as an anchor structure and is also used for strain purposes on angles above 10 deg.

A two-pole tower of the anchor type is shown in Fig.

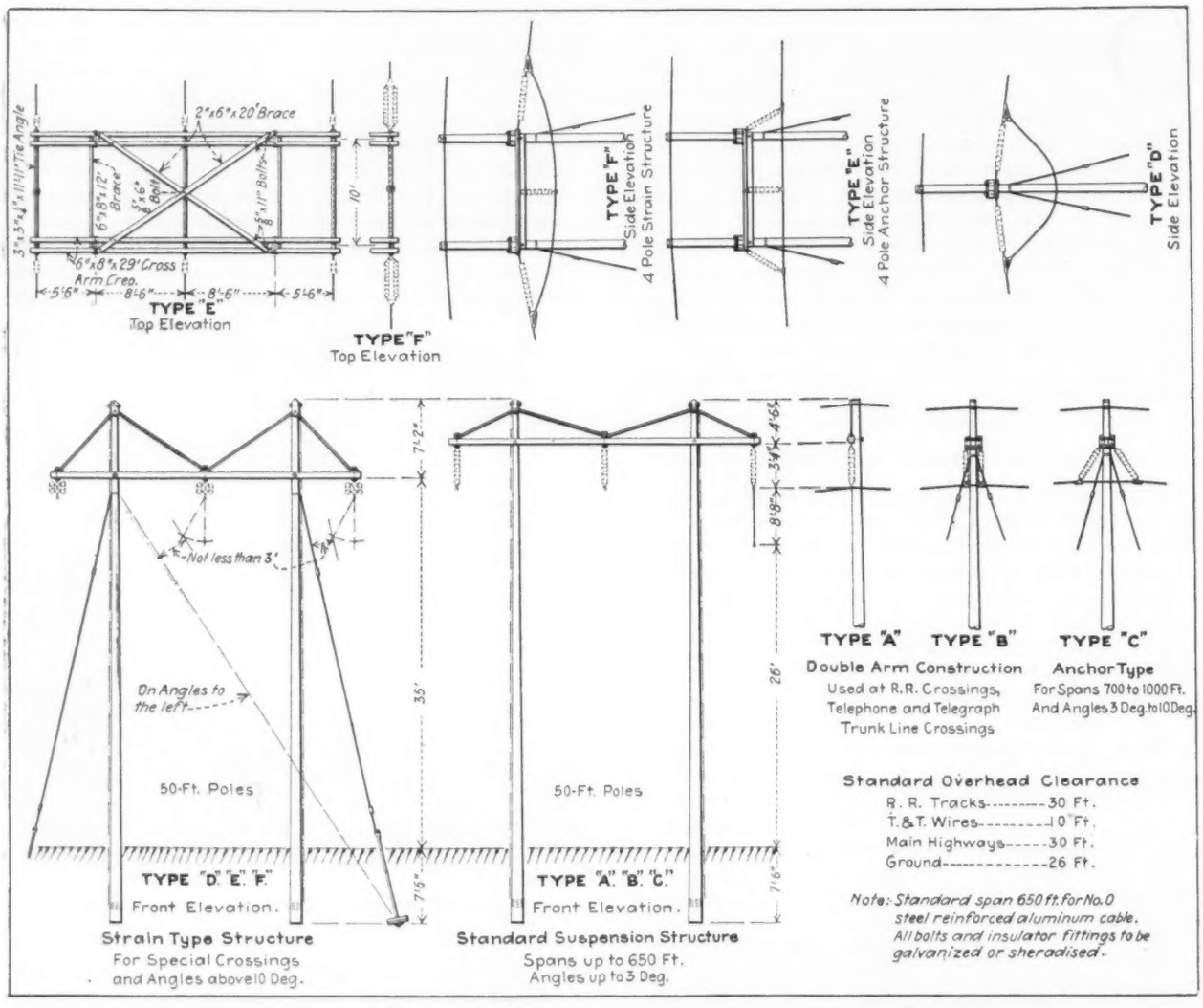

2"x6"x20' Brace
3"x3"x¼"x1'11" Tie Angle
6"x8"x12" Brace
5"x6" Bolt
8"x11" Bolts
10'
6"x8"x29' Cross Arm Creo.
5'-6"
8'-6"
8'-6"
5'-6"
TYPE "E" Top Elevation
TYPE "F" Top Elevation
TYPE "F" Side Elevation 4 Pole Strain Structure
TYPE "E" Side Elevation 4 Pole Anchor Structure
TYPE "D" Side Elevation
7'-2"
Not less than 3'
On Angles to the left
35'
50-Ft. Poles
7'-6"
TYPE "D" "E" "F" Front Elevation.
Strain Type Structure
For Special Crossings and Angles above 10 Deg.
8'-8"
3'-4"
4'-6"
26'
50-Ft. Poles
7'-6"
TYPE "A" "B" "C" Front Elevation.
Standard Suspension Structure
Spans up to 650 Ft. Angles up to 3 Deg.
TYPE "A" Double Arm Construction
Used at R.R. Crossings, Telephone and Telegraph Trunk Line Crossings
TYPE "B"
TYPE "C" Anchor Type
For Spans 700 to 1000 Ft. And Angles 3 Deg. to 10 Deg.
Standard Overhead Clearance
R. R. Tracks---------30 Ft.
T. & T. Wires---------10 Ft.
Main Highways-------30 Ft.
Ground---------------26 Ft.
Note: Standard span 650 ft. for No. 0 steel reinforced aluminum cable. All bolts and insulator fittings to be galvanized or sheradised.

FIG. 2—UNDER CERTAIN CONDITIONS WOOD-POLE LINES OFFER A CHEAP METHOD OF HANDLING THE TRANSMISSION PROBLEM

High-voltage wood-pole structures built by the Alabama Power Company are divided into two main types—four-pole and two-pole structures. For different locations and spans there are various arrangements of the insulators, number of cross-arms, method of guying, height of and size of poles. The conditions under which each type is used are outlined in the body of the article.

3 for spans of 700 ft. to 1,000 ft. (210 m. to 300 m.) and angles of 3 deg. to 10 deg. The pole and cross-arm sizes are the same for this structure as for the four-pole tower.

A double-arm suspension structure which is used at railroad crossings, telephone and telegraph trunkline crossings is shown in Fig. 4. For ordinary straight runs with spans of 440 ft. to 700 ft. (133 m. to 210 m.) and angles up to 3 deg. this same type of tower is used with the exception that one cross-arm is used instead of two.

The standard span for this line is 400 ft. (120 m.), although the special four-pole structure is designed for spans of more than 1,000 ft., and the anchor-type, two-pole structure for spans from 700 ft. to 1,000 ft. The clearance allowed over railroad tracks is 30 ft. (9 m.), while 10 ft. (3 m.) is allowed over telephone and tele-

TABLE II—BILL OF MATERIAL FOR 110,000-VOLT SINGLE-CIRCUIT WOOD-POLE TRANSMISSION LINE

Type of Construction (No. Required)						Description	Material
A	B	C	D	E	F		
2	..	..	..	..	..	50-ft. pole, 8-in. top	Chestnut
..	2	2	..	..	..	50-ft. pole, 8-in. top	Chestnut
..	..	..	2	4	4	50-ft. pole, 8-in. top	Chestnut
1	2	2	2	4	4	6x8-in. x 29-ft. cross-arm, creo. L.L. Y.P.	Chestnut
..	..	..	..	2	2	6x8-in. x 12-ft. brace	Chestnut
..	..	..	..	2	2	2x6-in. x 20-ft. brace	Chestnut
..	3	3	3	..	..	3x3x¼x23-in. tie angle	Steel-galvanized
..	..	..	..	3	3	3x3x¼-in. x 11 ft., 11-in. tie angle	Steel-galvanized
..	3	3	3	6	6	3x¼x18½-in. tie plate	Steel-galvanized
3	..	..	..	..	..	⅝x13-in. eye bolt with two washers	Steel-galvanized
2	4	4	..	..	..	⅝-in. diameter tension rod	Steel-galvanized
2	4	4	..	..	..	⅝-in. diameter tension rod	Steel-galvanized
..	..	..	4	8	8	⅝-in. diameter tension rod	Steel-galvanized
..	..	..	4	8	8	⅝-in. diameter tension rod	Steel-galvanized
1	2	2	2	4	4	Tension rod ear R.H.	Steel-galvanized
1	2	2	2	4	4	Tension rod ear L.H.	Steel-galvanized
2	..	..	..	..	..	⅝x10-in. mach. bolt, 4-in. threads, one washer	Steel-galvanized
..	8	8	8	16	16	⅝x10-in. mach. bolt, 4-in. thread, no washer	Steel-galvanized
2	..	..	..	4	4	⅝x18-in. mach. bolt, 4-in. thread, two washers	Steel-galvanized
..	2	2	2	4	4	⅝x24-in. mach. bolt, 4-in. thread two washers	Steel-galvanized
2	2	2	2	4	4	⅝x11-in. mach. bolt, 4-in. thread, one washer	Steel-galvanized
..	..	..	..	8	8	⅝x11-in. mach. bolt, 4-in. thread, two washers	Steel-galvanized
..	..	..	..	1	1	⅝x6-in. mach. bolt, 4-in. thread, two washers	Steel-galvanized
4	4	4	4	16	16	¾-in. standard round washer, 1-in. thick	C.-I.
2	..	..	..	..	..	4x4x¼-in. washer, ⅞-in. hole	Steel-galvanized
8	2	2	2	22	22	3x3x¼-in. washer, ⅞-in. hole	Steel-galvanized
2	10	10	14	16	16	Three-bolt clamp with ¾-in. bolt for ¾-in. cable	M.I. galvanized
2	4	4	4	8	8	Ground clamp American Bridge Co.	Steel-galvanized
..	4	4	6	6	6	¾-in. x 7 ft. "Never Creep" anchor rod	Steel-galvanized
..	4	4	6	6	6	¾-in. thimble	Steel-galvanized
..	200	200	300	300	300	¾-in. seven-strand guy wire, S. M.	Steel-galvanized
120	120	120	120	120	120	No. 6 double-galvanized solid wire	Steel-galvanized
50	50	50	50	50	50	Wire staple 1½ in.	Steel-galvanized
25	25	25	25	25	25	⅝x9-in. pole steps	Steel-galvanized
21	42	48	96	69	117	Suspension insulator units, O.B. cat. No. 12464	Porcelain
3	6	6	..	9	3	Insulator hook, O.B. cat., No. 7092	M.I. galvanized
3	6	..	..	3	3	Susp. clamp, O.B. cat., No. 11551	M.I. galvanized
..	..	6	..	6	..	Strain clamp, O.B. cat., No. 11949	M.I. galvanized
..	..	..	6	..	6	Strain clamp	M.I. galvanized
..	..	..	6	..	6	Strain yoke, upper O.B. cat., No. 11-686	M.I. galvanized
..	..	..	6	..	6	Strain yoke, lower O.B. cat., No. 11688	M.I. galvanized
3	6	6	6	9	9	Cable shields	Aluminum

graph wires. Over main highways the clearance is 30 ft., and at other places the clearace above the ground is 25 ft. (7.5 m.).

In the second line the same general construction type was followed, the most important change being that tension rods were substituted for the bow braces, as it was believed that thus less trouble would be experienced and a longer life obtained. Besides, a further saving in cost was effected by this method of bracing.

As shown in Fig. 2, two main types of structures were used, although each of these has several arrangements, making a total of seven types of structures.

The distance between the poles of each H-frame was

FIG. 3—TWO-POLE TOWER OF THE ANCHOR TYPE USED FOR SPANS OF 700 FT. TO 1,000 FT.

also changed to 17 ft. (5.1 m.), since it was found on the first line that the cross arms with the 14-ft. (4.2-m.) pole spacing had a tendency to bow up in the middle of the arm and sag at the ends, especially on long spans where the load was appreciable. With the larger pole spacing the cross-arms are standing absolutely straight.

The standard span is 650 ft. (195 m.) for No. 1/0 steel reinforced-aluminum cable. Over railroad tracks

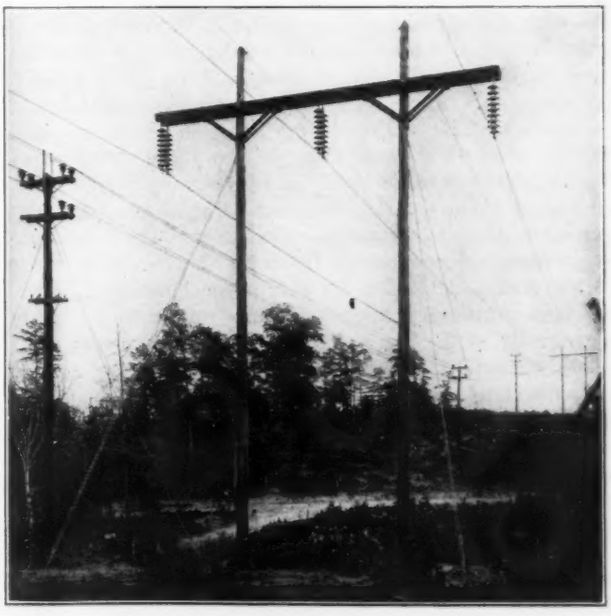


FIG. 4—DOUBLE-ARM SUSPENSION STRUCTURES USED AT RAILROAD, TELEGRAPH AND TELEPHONE CROSSINGS

For ordinary runs of from 440-ft. to 700-ft. span this same type of tower is used with only one cross arm. When the second line was built the bow braces were changed to tension rods above the cross arms.

the clearance allowed is 30 ft.; over telephone and telegraph wires it is 10 ft., over main highways 30 ft., and at other places 26 ft. from the ground. The four-pole tower known as type E and F is used for special crossings and angles above 10 deg. as well as for an anchor structure. The method of insulator arrangement can be noted in Fig. 2. The bill of material shows the items that go into the various types.

The type D tower is a two-pole structure with double cross-arms and is used for special crossings. Type E, which is a four-pole tower, is used as an anchor structure with the insulator arrangement shown in Fig. 2. It should be noted that the method of cross bracing differs slightly from that used in the first line. The end bracing of the four-pole structure consists of 3-in. x 3-in. x ¼-in. (7.5-cm. x 7.5-cm. x 6.3-mm.) angle iron, and at the poles 6-in. x 8-in. (15-cm. x 20-cm.) long-leaf yellow pine is used. Two diagonal braces made up of 2-in. x 6-in. (5-cm. x 15-cm.) creosoted long-leaf yellow pine are added to give rigidity. One of the 3-in. x 3-in. x ¼-in. angle-iron braces is also provided at the center of the structure.

Types A, B and C are used for spans up to 650 ft. (195 m.) and angles up to 3 deg. The type A is a single cross-arm double-pole structure used for ordinary straight-line suspension runs. The type B structure is very similar, with the exception that two cross-arms are used, one on each side of the poles, to give additional strength. This particular type is used at railroad crossings and telephone and telegraph trunk line crossings. The chief difference between the type B and the type C is the arrangement of insulators.

From the cost data in Table I it may be seen that the largest item in the cost of this line was for poles and fixtures, this material amounting to $1,678. The labor in connection with erecting the structure cost $676, while the labor cost of stringing the wires was $217 per mile. The cost of the wires and miscellaneous items used with the wire was $869. The direct construction cost came to $3,950.

The first line has now been in operation more than three years, and the maintenance costs have been practically nil. The same applies to the second line, which has been in operation about two years. Another line of the same type is now in course of construction which is identically the same as the second line described above, with the exception that the tension rods are made of ⅝-in. diameter instead of ½ in. (1.25 cm.) and creosoted poles are used for this line. Any further lines of this type will follow the design of this latest line.

Repair Defects Before They Mature

Trouble Must Be Anticipated by Means of Detailed Inspection at Prescribed Intervals If Costly Interruptions to Operation Are to Be Avoided—Typical Arrangement of Schedules and Forms

By W. G. SCHMAUDER
Assistant General Manager Texas Power & Light Company

ENGINEERS responsible for maintenance of mechanical equipment in a generating station have long since learned that good maintenance does not consist in repairing failures as they occur. Experience has taught them that defects must be found early in their development and repaired before they mature. Consequently they have established maintenance schedules which bring about detailed inspections at prescribed intervals. Station forces who have become accustomed to such schedules swear by them and accept them as their religion. They have faith in equipment that is properly maintained. They do not live in dread of unexpected failures.

Maintenance schedules for electrical equipment, more especially stationary apparatus, has not been adopted as generally as for mechanical equipment, but they are no less important. An insulator breakdown may cause just as serious and just as costly an interruption as a turbine failure. Systematic inspection combined with authentic detailed records is the basis of good maintenance, whether the scheme is carried out by means of a calendar tickler file and a day book or a more elaborate schedule of card files, form notices and ledgers.

A schedule cannot be prescribed to suit any and every property, but an outline of a working schedule will carry fundamental ideas that can be applied to suit individual cases. In general, inspections to fit the apparatus are tabulated and serially numbered, either on cards or in book form. Inspections in book form are very convenient for employees responsible for maintenance, in that they enable them to carry inspection records with them. The following examples of inspections give a general idea of their nature:

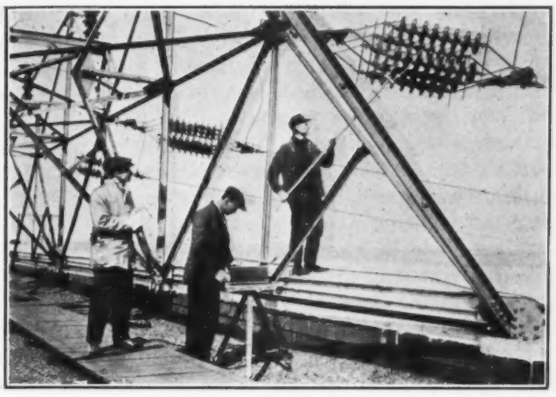
No. 17, Lightning Arresters, 104 Weeks.—Aluminum cell: Complete overhaul. (See manufacturer's instruction book).

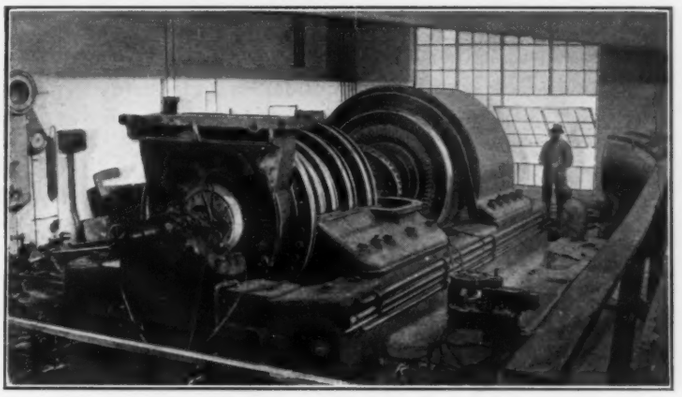
No. 52, Low-Tension Wiring, Thirteen Weeks.—General inspection: Note particularly that all accessible live parts such as current and potential transformers, connection lugs and oil-switch terminals are insulated either by taping or fiber board. The insulation of switch terminals is of particular importance to prevent short circuits by rats, mice and other animals.

No. 67, Potential Regulators, 156 Weeks.—Completely dismantle for internal and external inspection, paying particular attention to upper and lower bearings and to clearance between rotor and stator. Change or filter oil. Paint motor windings with air-drying varnish, and note condition of bearings. (See Handbook, S-25).

The engineer who is responsible for maintenance must exercise his judgment on the theory of probabilities and fix inspection periods for every piece of apparatus. Knowing what is to be inspected and how often, the next step is to lay the scheme out on the calendar. The task is so to juggle the inspection dates as to carry on the work with a minimum crew and a minimum amount of traveling.

On the system of the Texas Power & Light Company maintenance work is in charge of division engineers, each being responsible for approximately fifty stations and 500 miles (926 km.) of line. These divisions are subdivided into patrolmen's districts, including five to ten stations and 50 miles to 100 miles (92 km. to 185





CAREFUL MAINTENANCE WORK HAS BEEN FOUND TO PROLONG THE USEFUL LIFE OF APPARATUS, BESIDES ASSURING CONTINUITY OF SERVICE

km.) of line. Cards are prepared showing inspections due in each individual district for any given week, as shown in the illustration, and these are filed in date order. A clerk in the division engineer's office on Monday of each week picks the cards for the following week and advises the patrolman or maintenance foreman by written memorandum as to inspections due at each station. When the inspections are completed, the memorandum is returned with notes as to what was found, and where work is not finished its status is indicated on the returned memorandum and such inspection then continues to show on the weekly list as "delayed" until it is cared for. The field notes are transcribed by the clerk into a ledger, classified first as to district, second as to station, third as to section, building and yards, high-tension, low-tension or transmission. With space allowed for individual pieces of apparatus, it is usually desirable to show name-plate rating, from whom purchased, date installed, etc., at the beginning of the sheet, so that the ledger will constitute a complete history.

The rugged equipment of today requires little care, but if it is to be maintained in a reasonable state of operating efficiency, the little care must be administered methodically. High-tension transformers have operated ten years without care, filtering or replenishment of oil and then, when they were dismantled for inspection, promptly failed upon being returned to service. Delayed maintenance permitted early deterioration. True, had the transformers not been disturbed they might have operated for twelve or even fifteen years, but, on the other hand, had reasonable care been accorded to them from the date of installation their useful life could have been doubled.

Experience must be applied and good judgment exercised in fixing the inspection period. A half-way point must be reached between too frequent inspections, which unnecessarily and unreasonably burden maintenance costs, and prolonged periods, on the other hand, which permit unexpected failures. Insulator deterioration illustrates this point. Ten-inch disks under tension, installed in 1913, began to fail in 1916. Preliminary tests indicated that strain units had deteriorated at the rate of 5 to 10 per cent per year, while suspension units were only going at the rate of 1 to 5 per cent. Considering the high cost of replacing units in tension, all strains were removed and replaced with new porcelain. The disks passing test were then used in replacing faulty suspension units. During the years 1916, 1917 and 1918 all insulators were tested annually, but when not a single failure developed on the new units under tension and no more rapid depreciation took place on those in suspension, the schedule was changed to read every three years for the strain units and every two years for those under suspension. Tests in 1921 have developed the fact that some of the porcelain installed in 1916 has not developed a single failure to date. The same story is true in regard to pin-type porcelain. One 22-kv. line constructed in 1916 has had but twelve insulator failures, and these insulators were shattered by flashover, whereas other 22-kv. lines built at the same time have had their insulators culled at the rate of 8 per cent a year. Obviously, the inspection period for porcelain will depend wholly upon the quality.

The only criticism of periodic inspections is with reference to costs. Are they warranted? Do they pay meager or handsome returns on the investment represented by cost of breakdown? The results tell their own story. On a recent inspection five arrester grounds

MAINTENANCE OF EQUIPMENT
TRANSMISSION SYSTEM

McKinney District — 15th Week

STATION	Section	Insp.	STATION	Section	Insp.	Station	Section	Insp.	Station	Section	Insp.
Jenkins	1	3,7	Murphy	1	3,7	Wylie	1	3,7			
"	2	13,18	"	2	13,18	"	2	13,18			
		29,41						29,41			
McKinney Sub-sta.	1	3,7	Plano	2	13,18	Allen	1	3,7			
"	2	13,18			29,41	"	2	13,18			
		29,41			52,61			29,41			
"	3	52,61									
McKinney Gen. Sta.	1	4,8	Richardson	1	3,7						
"	3	52,63	"	2	13,18						
					29,41						

INSPECTIONS BY PATROLMEN ARE DIVIDED INTO DISTRICTS AND SCHEDULED BY WEEKS

out of twenty-five were found to have a resistance of 25 ohms or more. The five arresters represented an investment of $240, which protected equipment valued at $2,500. The tests on the twenty-five grounds cost $3.50. The testing of grounds, too, should be mandatory from a safety standpoint. Broken bellows, leaks in dash pots and welded contacts on relays, inoperative toggles on oil switches, broken connections on trip coils, all render useless equipment which has been installed at a big cost. Systematic maintenance can be overdone, but the common fault lies in its being underdone.

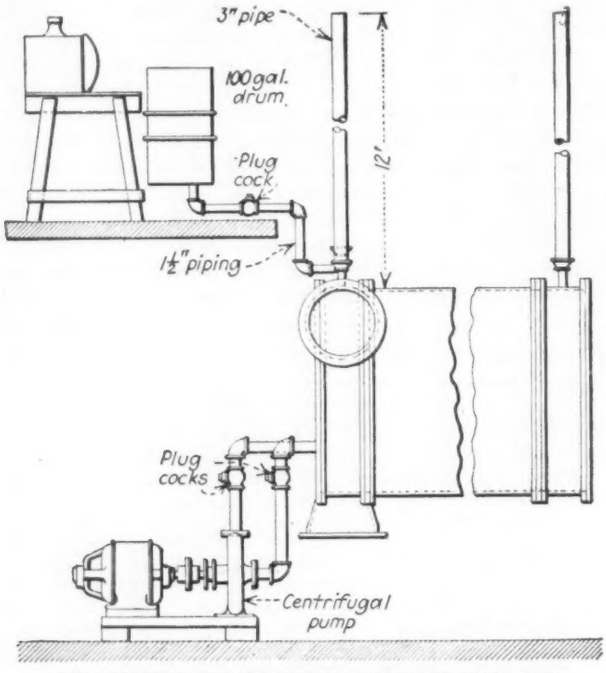
Acid Cleaning of Condensers

Cost Is About 20 per Cent that of Mechanical Cleaning of Old Water-Tube Condensers, Because Loss of Tubes Is Negligible

BY NORMAN G. HARDY
Chief Electrical and Mechanical Engineer Arizona Copper Company, Ltd.

HYDROCHLORIC acid has been used to clean condensers the past two years with very good success at the generating station of the Arizona Copper Company, Ltd., Clifton, Ariz. The condensers on which this outfit is used have a tube area of 7,600 sq.ft. in 2,500 ¾-in. x 15-ft. 1-in. Muntz-metal tubes and are used for condensing steam from 2,000-kw. turbo-generators. The condensers have two passes with vertical diaphragms between water inlet and outlet compartments. The arrangement of apparatus is shown in the drawing.

Before using the acid both heads are removed from the water boxes, the tubes are washed out with hose, and the scale is cleaned from the water boxes, the heads and, so far as practicable, from the tube sheets also. After drying thoroughly, the water boxes, heads and



ARRANGEMENT FOR CLEANING CONDENSER WITH ACID

tube sheets are painted with two coats of roofing cement, which is better than acid-proof or asphaltic paints.

Cover plates with gaskets are fastened over the water inlet and outlet with cap screws tapped into the water box. The heads are then replaced and the apparatus connected up. A temporary platform is erected on the operating floor from which the acid is poured into the mixing tank. This tank is a 100-gal. steel drum with one head cut out and having 1½-in. pipe connecting from the bottom of the tank to the top of the water box on the condenser. Vent pipes about 12 ft. long are placed at the top of each water compartment. The water boxes are tapped for a 1½-in. pipe and have a short nipple and reducer to connect to the 3-in. vent pipe. These vent pipes are very necessary as it has been found that the generated gas will blow water out if a height less than 12 ft. is used.

To circulate the solution a 2-in. brass centrifugal pump with direct-connected motor drive is the most satisfactory. It is desirable to circulate the solution at as high a velocity as possible to prevent the gases generated from forcing the solution out of the tubes.

Commercial hydrochloric acid averaging about 24 per cent HCl is employed. The water boxes and tubes hold 7,800 lb. of water and 1,000 lb. of acid for one cleaning, making the solution about 3 per cent HCl. The condensers are filled by running the acid and the water in at rates calculated to give the proper mixture. As soon as the level in the condenser rises above the pump suction the pump is started. The pump is run for four to five hours, when the acid is entirely neutralized. The solution is usually not drained from the condenser until the following day. After removing the solution one head is removed and each tube is washed out with a stream of water. Each tube is then brushed with a round wire brush on the end of ¾-in. pipe, through which water is supplied to the brush.

The amount of scale actually dissolved is relatively small, being equivalent to a thickness of about 0.001 in. The great benefit of acid treatment is that it softens and loosens the scale so that it can be easily removed by washing and brushing. If a condenser is very dirty, it is more economical to treat it several times with a weak acid solution, washing out the loosened material between treatments, rather than to use a stronger solution less often.

Objections to the use of acid for cleaning are the high cost and the possibility of injury to the tubes and packing. The first of these is undoubtedly justified and eliminates this method in any case where the tubes are in good condition and the scale is not too hard to permit mechanical cleaning. As regards the second objection, the experience of two years indicates no serious deterioration of the tubes as a result of using acid. These condensers have been in service for seven and one-half years. For several years they were cleaned with mechanical cleaners very satisfactorily, but later, as the tubes became brittle from dezincification, the tube loss increased rapidly until two years ago it amounted to several hundred tubes at each cleaning. Since using acid for cleaning the loss has been negligible.

CLEANING CONDENSERS WITH ACID CHEAPER THAN WITH MECHANICAL CLEANERS

Condenser tube area is 7,600 sq.ft. in 2,500 ¾-in. by 15-ft. Muntz-metal tubes

	Acid Process	Mechanical Process
Labor, cleaning, etc.	$43.71	$51.12
Hydrochloric acid (1,000 lb.)	147.00	.....
Brushes, paint, etc.	5.00	.....
Cleaner tools, repairs, etc.	.....	10.00
*Tubes, 200	.....	958.00
Labor, replacing tubes	.....	70.00
Total	$195.71	$1,089.12
Saving by acid-cleaning		893.41

* With present condition of condensers at least 200 more tubes would be lost by mechanical than by acid cleaning.

Some indications have been found of local corrosion of the cast-iron tube sheets and heads resulting from defects in the paint film, but it is thought that the damage will not be serious for several years. As yet there is no indication that the tube packing is being injured by the acid solution. Tests on samples of the tubes and iron showed little destructive action.

With labor and material costs as they were in the early part of 1921, the cost of cleaning a condenser averaged as shown in the appended table.

Order System for Coil-Winding Shop

A 4-in. x 6-in. Card Holds All Information Necessary for Carpenter, Coil Winder, Puller and Taper to Wind, Shape and Insulate Set of Coils for Almost Any Machine—Saves Much Written Instruction and Repetition of Orders

By A. C. ROE
Detroit Service Department, Westinghouse Electric & Manufacturing Company

IN ANY large motor-repair shop where coils are wound many instructions must be given to the coil department telling what type of coil and insulation to use in making up a set of coils. Moreover, there is much repetition of work as the methods of making and insulating coils are often the same for motors of different manufacture, speed, size, etc. In order to set down this information in a concise form and to obviate the repetition of instructions on duplicate work a system has been developed which saves much time and trouble. All the instructions for a set of coils are placed on a small card, which is handed to the coil department. This card is passed successively to the carpenter who makes the mold or the shuttle, to the winder and to the coil puller and taper, etc. In developing the cards the coil records of a large shop for two years were studied, with the result that a few symbols and instructions were chosen to cover virtually all types of coils.

For holding the necessary information a standard 4-in. x 6-in. card (A, Fig. 1) is used. The arrangement of the card and the wording were carefully thought out to make it apply to all types of coils. The back of the card is used for coil dimensions shown diagrammatically. The top line on the face of the card is reserved for the order number and the name of the customer to whom time and material are charged. The next three lines may be used, if desired, for such data as type of motor, horsepower, voltage, serial and style numbers, etc., but as each motor repaired receives a separate order number the nameplate data are not necessary for this card. It is a simple matter to find such data in a file in which a 6-in. x 8-in. card is kept for each customer.

On the fourth line of the card *MLD* (mold) is printed to give the mold number on which the coils are to be made. This number is entered only when a mold already in stock is to be used or when it is necessary to make a mold valuable enough to warrant storing. In a later issue the system of storing molds will be described.

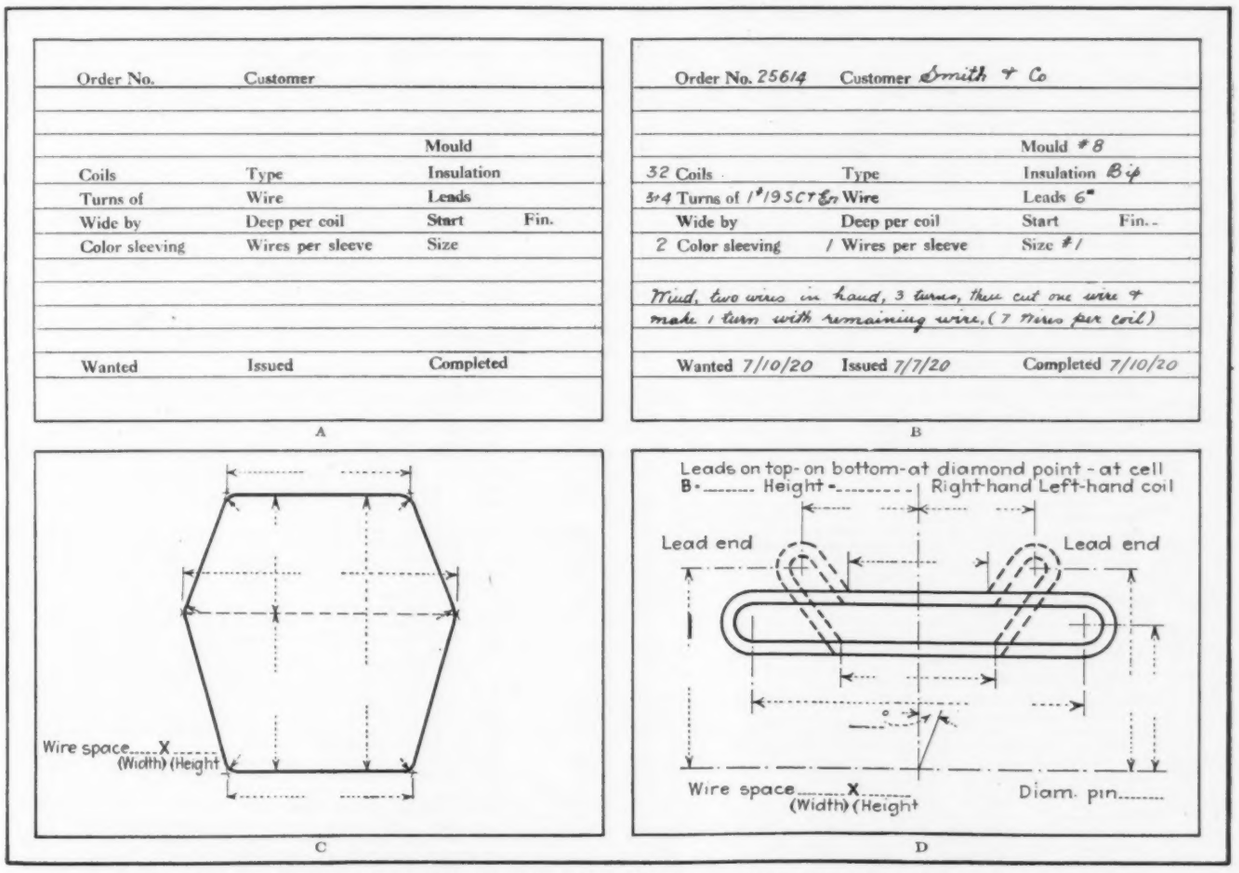
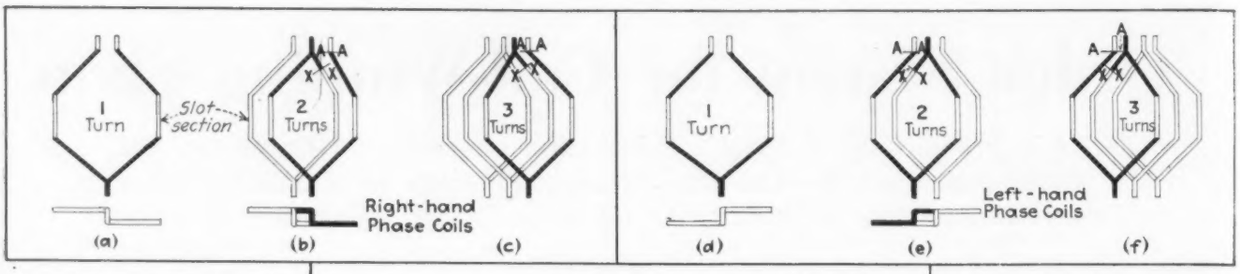
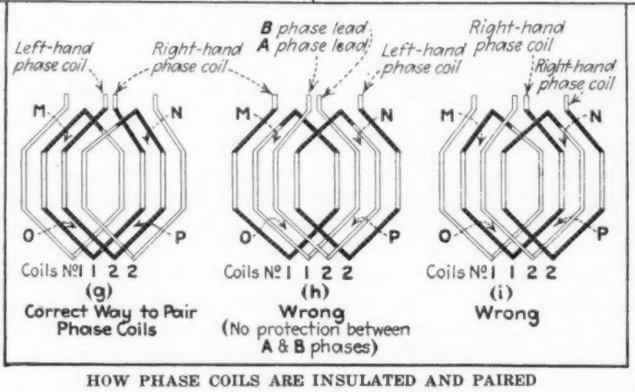

Order No. Customer
Mould
Coils Type Insulation
Turns of Wire Leads
Wide by Deep per coil Start Fin.
Color sleeving Wires per sleeve Size
Wanted Issued Completed
A
Order No. 25614 Customer Smith & Co
Mould #8
32 Coils Type Insulation Bip
3+4 Turns of 1"195CT&T Wire Leads 6"
Wide by Deep per coil Start Fin.
2 Color sleeving 1 Wires per sleeve Size #1
Mind, two wires in hand, 3 turns, then cut one wire & make 1 turn with remaining wire, (7 wires per coil)
Wanted 7/10/20 Issued 7/7/20 Completed 7/10/20
B
Wire space X
(Width) (Height)
C
Leads on top- on bottom-at diamond point - at cell
B- Height - Right-hand Left-hand coil
Lead end
Lead end
Wire space X
(Width) (Height)
Diam. pin
D

FIG. 1—CARD FOR DATA TO DIRECT MOLD MAKER, COIL WINDER, PULLER AND INSULATOR IN MAKING COILS

Used for all types of coils. A is face of card and diagrams C or D are on reverse side. B shows form filled for a special mush coil. This shows the use of the blank lines at the bottom of the card. A mush-coil diagram is on the reverse side. C is the diagram for mush coils, while D is the diagram which is used for puller coils.





HOW PHASE COILS ARE INSULATED AND PAIRED

The nine figures, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, illustrate how phase coils are insulated and paired for induction motors wound with strap-copper coils and having partly closed slots into which the coils are threaded, one conductor at a time. First, the total number of phase coils required is found by the formula: P. C. = 2 × number of poles × number of phases. For instance, a four-pole, three-phase motor would have 2 × 4 × 3 = 24 phase coils. Then the total number of phase coils are divided into two equal piles, one pile being called left-hand phase coils and the other pile being called right-hand phase coils.

The first right-hand turn for right-hand phase coils (with leads away from you) as *AA* to *XX* in drawings (*b*) and (*c*) should be taped with one-half-lapped layer of Empire tape (0.008 in. thick), this tape being applied to the section of coil that is shown dark in the drawings; *i.e.*, the end parts of the coil (from wrapper to wrapper). Then one layer of red cotton tape is applied over the Empire tape, the red tape being wrapped also over the insulating cell on the slot section of the coil. Red tape starts at *AA* and ends at *XX*, from which point one layer of white tape is applied, the manner of lapping depending upon the insulation desired. The left-hand phase coils are taped in the same manner except that the taping starts on the left-hand turn of the coil as shown as in the drawings *d*, *e* and *f*.

The correct method of pairing phase coils is shown in drawing *g*. Two incorrect methods are shown in *h* and *i*. First, a left-hand phase coil and a right-hand phase coil must be paired together. The extra-insulated leads for both coils (those leads with the red tape) must be placed adjacent to each other as in Fig. *g*. When the coils are placed in this position the end portions of the coils which are adjacent, as *M*, *N*, *O* and *P* in Fig. *g*, are doubly insulated from each other.

When a right-hand and a left-hand phase coil are paired together, as shown in Fig. *h*, there is no extra protection between the adjacent end portions of the coils, as in *M*, *N*, *O* and *P*, in Fig. *h*. This method of connection is accordingly incorrect. Likewise, it is wrong to connect two right-hand or two left-hand phase coils together as in Fig. *i*. In this case only half the insulation required is present between the end portions of the coils as illustrated at *M*, *N*, *O* and *P*, in Fig. *i*.

TABLE I—SYMBOLS FOR DIFFERENT TYPES OF COILS WITH OPERATIONS AND TIME REQUIRED

Symbol	Manufacturing Information	Operations Involved	Days*
M	(Mush). Coils wound hit-and-miss, *i.e.*, not wound in layers.....	Make mold, wind....	1–2
M-P	(Mush pullers). Coils mush-wound on shuttle and pulled to final shape. Starting and finishing leads sleeved while winding and tied in place when pulling with two turns of light flax cord; knot tied on top, four cord bands per coil, two at each end, one inch either side of the diamond point.	Make shuttle and puller blocks, wind pull.....	1–3
C-M	Same as M, except C-M coils require more than one mold.....	.....	1–4
T-P	(Threaded puller). Wire-wound coils, for partially closed slots, the coils being wound in layers on a shuttle and pulled to final shape. Starting lead only is taped with 0.004-in. x ¾-in. cotton tape, while winding. When pulling, the lead end of coil is taped around the diamond point and one inch either side with 0.007x¾-in. cotton tape, half over-lapped. The coil leads are not caught under this tape, but are tied down with cord bands consisting of $\frac{1}{16}$-in. diameter cord, twelve turns per band, four bands per coil, two at each end. Coils are dipped in thin plastic varnish before pulling.	Make shuttles and blocks, wind, pull, dip, bake.....	1–5
Mld-A	(Mold A). Coils wound to final shape on a mold for 110-volt to 220-volt open-slot A.C. and D.C. machines. All leads sleeved while winding, and a thin paper cell glued in place on slot section of coil to hold it rigid. The required number of single coils are then assembled (with glue between) to make a whole coil, then hot-pressed, a one-and-a-half turn treated-cloth wrapper is applied on slot section, and the coil is then taped all round with 0.007x¾-in. cotton tape half-lapped on ends and spaced on wrapper. Phase coils same as for P-C-A.	Make mold, wind, assemble, press, dip in plastic varnish, wrap, dip in varnish, tin leads.....	3–6
Mld-B	(Mold B). Same as Mld-A, except for 440 volts and 550 volts. Insulate as per P-C-B.....	See Mld-A.....	3–6
Mld-H	(Mold H). Same as Mld-A, except for 1,000 volts and 2,300 volts. Insulate as per P-C-H.....	See Mld-A.....	3–9
Bip	(Bipolar). Coils wound flat mush, for open-slot machines. Leads sleeved while winding, coils taped with 0.004-in. x ¾-in. cotton tape, half-lapped all round (semi-tight), coils not dipped.	Mold, wind, tape.....	1–3
Bip-B	(Bipolar B). Same as Bip, except that coils are taped on ends only, *i.e.*, from slot section to slot section.	See Bip.....	1–3
C-W	Diamond-point pulled coils, which are wound in layers on a shuttle, sleeved while winding, pulled to shape, then taped all round with 0.007-in. x ¾-in. cotton tape, half-lapped (holding wires square and even while taping). Dip once after taping in plastic varnish.	Make shuttle and blocks, wind, pull, tape, dip.....	2–5
P-C-A	(Puller coil A). Wire-wound and insulated coils for open-slots, 110 to 220 volts. A.C. and D.C. Coils are wound in layers on a shuttle, starting and finishing leads sleeved, slot section of coil held rigid by shellacked strips or paper cells; pulled to shape, leads tied, dipped in plastic varnish. While taping a one-and-a half turn treated-cloth wrapper is applied on slot sections and whole coil is taped with 0.007-in. x ¾-in. cotton tape, half overlapped on ends and spaced on the wrapper. For A. C. machines the phase coils are reinforced with one layer of 0.008-in. x ¾-in. bias treated-cloth tape, half overlapped on each end, sealing the ends of wrapper and extending from wrapper to wrapper. The phase coils are painted red at the lead end, or longer leads used to distinguish these coils.	Make shuttles and blocks, place strips or cells, pull, dip in plastic varnish, tape, dip in clear varnish, tin leads..	3–6
P-C-B	(Puller coil B). Same as P-C-A, except that it applies to 440-550-volt A.C. and D.C. machines and that a one-and-a-half turn mica and fishpaper wrapper is used, instead of treated cloth.	See P-C-A.....	3–6
P-C-H	(Puller coil H). Same as P-C-B, except that it applies to 1,000 to 2,300-volt A. C. machines. A two-and-a-half-turn mica and fishpaper wrapper is used for 1,000 volts to 1,110 volts, and for 1,100 volts to 2,300 volts a three-and-a-half-turn mica and fishpaper wrapper is used, and all coils (1,000-2,300) are reinforced on ends with one layer of 0.008-in. x ¾-in. bias treated-cloth tape half-lapped, the phase coils having two layers of treated-cloth tape with varnish brushed on between layers and all coils dipped three times in a clear varnish. After taping coils are sandpapered between dips to give a smooth and glossy finish.	See P-C-A.....	3–9
Ren-A	(Reinsulate A). Reinsulating strap-copper coils for A.C. and D.C. 110-volt to 220-volt open-slot machines, having one to five straps per coil. Tape odd-numbered straps, on ends only (part outside of slot section), with one layer of 0.007-in. x ¾-in. cotton tape, half-lapped; extend this tape ¾ in. onto slot section of coil and dip coils in plastic varnish. Then use a one-and-a-half-turn mica and fishpaper wrapper, interwoven between straps, on slot section; tape with 0.007-in. x ¾-in. cotton tape, half-lapped on ends and spaced on wrapper. When phase coils same as P-C-A are required, dip coils in clear varnish; otherwise dip coils in plastic varnish.	Clean, tin leads, reform, assemble, dip, wrap, dip, tin or clean leads.....	1–14
Ren-B	(Reinsulate B). Strap-copper coils for 440-volt and 550-volt open-slot machines, same as Ren-A, except tape all straps on ends and use a two-and-a-half-turn mica wrapper.	See Ren-A.....	1–14
Ren-C	(Reinsulate C). Strap-copper coils for threaded-in (partly-closed-slot) machines. Each strap should have a one-and-a-half-turn mica and fishpaper wrapper on the slot section; *i.e.*, a two-turn coil would have four wrappers and a three-turn coil six. The coil is taped with one layer of 0.004-in. x ¾-in. cotton tape, half-lapped on ends and spaced on cell part. Phase coils should be half rights and half lefts, see Figs. a, b, c, d, e, f, g, h, i (above), which show how the phase coils are insulated and assembled.	.....	1–14

*Days required to make a set of coils (minimum and maximum).

TABLE II—LINEAR SPACE OCCUPIED BY DOUBLE-COTTON-COVERED WIRES LAID SIDE BY SIDE (INCHES)

No. of Wires	Wire Size, B. & S. Gage Number															
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
2	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
3	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
4	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
5	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
6	..	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
7	..	⅜	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
8	..	⅜	⅜	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
9	..	..	..	⅜	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
10	..	..	..	⅜	⅜	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
11	..	..	..	..	⅜	..	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
12	..	..	..	..	⅜	..	..	1	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜

On line 5 of the card are entered the number of coils, type and insulation required. In entering the last item certain symbols are used to designate certain types of coils. These symbols with their meanings are given in Table I, which also shows the operations and the time necessary for making a set of coils. This table should be readily accessible to the man who makes out the orders, and a copy should be posted in the coil-winding shop so that all who handle the order may know how the coil is to be made and insulated.

The turns per coil, size and kind of wire and length of leads are shown on line 6. The seventh line is used for the arrangement of the wires in the coil, *i.e.*, number of wires wide by number of wires deep. This line is not filled out for mush coils. At the end of the seventh line are the expressions "Start" and "Fin," signifying "start" and "finish," which are used only when one lead must be longer than the other. The words start and finish are used in preference to top and bottom as the average coil winder would not know the top lead from the bottom but would understand what lengths of wire to leave outside the mold when starting and finishing the coil. It is the duty of the person making out the order to apply these terms to the proper leads.

Line 8 is used to denote the number of colors of sleeving to use. For instance, an armature with forty-nine slots and ninty-eight bars would require two colors, while three colors would be required for 147 bars. The size of sleeving (diameter) to use should also be specified as well as the number of wires per sleeve. A sample sleeving card is quite helpful for determining the correct size. A snug fit should be chosen. If this choice is left to the coil winders they may select a sleeve that is too large because it will slide on the wire easily. Too large a sleeve will make a baggy appearance after dipping in paint.

Any other information that is absolutely necessary can be added on the following lines. On line 13 are entered the date on which the coils are wanted, the date the order was issued and the date on which the job was completed. An example of a card which has been filled out is shown at B, Fig. 1. The use of the extra lines at the foot of the card is illustrated. These

TABLE III—DIMENSIONS AND CROSS-SECTIONAL AREA OF BARE AND DOUBLE-COTTON-COVERED RIBBON WIRE

Size, Inches — Bare — Thickness	Size, Inches — Bare — Width	Size, Inches — Insulated — Thickness	Size, Inches — Insulated — Width	Area of Copper — Circ. Mils	Area of Copper — Square Inches
0.0126	0.1875	0.0295	0.2015	2,964	0.002328
0.0126	0.2500	0.0295	0.2645	3,967	0.003116
0.0159	0.1875	0.0330	0.2015	3,727	0.002927
0.0159	0.2500	0.0330	0.2645	4,992	0.003921
0.0201	0.2500	0.0370	0.2645	6,288	0.004939
0.0254	0.2500	0.0425	0.2645	7,909	0.006212
0.0285	0.1200	0.0455	0.1332	4,133	0.003246
0.0285	0.1500	0.0455	0.1635	5,222	0.004101
0.0285	0.2070	0.0455	0.2210	7,291	0.005726
0.0320	0.1000	0.0490	0.1130	3,794	0.002980
0.0320	0.1320	0.0490	0.1453	5,098	0.004004
0.0320	0.1800	0.0490	0.1938	7,084	0.005540
0.0320	0.2500	0.0490	0.2645	9,906	0.007780
0.0320	0.3750	0.0490	0.3900	14,999	0.011780
0.0370	0.0920	0.0540	0.1050	3,960	0.003110
0.0390	0.1230	0.0560	0.1363	5,693	0.004471
0.0390	0.1700	0.0560	0.1838	8,027	0.006304
0.0390	0.2630	0.0560	0.2778	12,645	0.009931
0.0403	0.1600	0.0573	0.1735	7,765	0.006099
0.0403	0.2050	0.0573	0.2190	10,075	0.007913
0.0403	0.2500	0.0573	0.2645	12,383	0.009726
0.0403	0.3150	0.0573	0.3300	15,719	0.012346
0.0403	0.3750	0.0573	0.3900	18,798	0.014764
0.0420	0.1350	0.0590	0.1473	6,683	0.005249
0.0430	0.1100	0.0600	0.1230	5,517	0.004333
0.0453	0.0880	0.0623	0.1010	4,515	0.003546
0.0453	0.1450	0.0623	0.1585	7,804	0.006129
0.0470	0.1700	0.0640	0.1838	9,570	0.007516
0.0474	0.1500	0.0645	0.1635	8,439	0.006628
0.0474	0.2700	0.0645	0.2848	15,682	0.012316
0.0474	0.3150	0.0645	0.3300	18,397	0.014449
0.0490	0.0950	0.0660	0.1080	5,271	0.004140
0.0490	0.1340	0.0660	0.1473	7,704	0.006051
0.0490	0.1810	0.0660	0.1948	10,637	0.008354
0.0490	0.3740	0.0660	0.3890	22,678	0.017811
0.0490	0.4370	0.0660	0.4520	26,608	0.020898
0.0508	0.0700	0.0678	0.0868	3,822	0.003002
0.0508	0.1170	0.0678	0.1303	6,863	0.005390
0.0508	0.1610	0.0678	0.1745	9,708	0.007625
0.0508	0.2500	0.0678	0.2645	15,464	0.012146
0.0520	0.2050	0.0690	0.2190	12,834	0.010080
0.0540	0.0780	0.0710	0.0950	4,566	0.003586
0.0550	0.0950	0.0720	0.1080	5,826	0.004576
0.0570	0.1340	0.0740	0.1473	8,836	0.006941
0.0590	0.1500	0.0760	0.1635	10,317	0.008103
0.0590	0.2050	0.0760	0.2190	14,449	0.011348
0.0590	0.3150	0.0760	0.3300	22,712	0.017838
0.0600	0.1170	0.0770	0.1303	7,954	0.006247
0.0600	0.1300	0.0770	0.1433	8,948	0.007028
0.0620	0.0880	0.0790	0.1050	5,896	0.004631
0.0641	0.0950	0.0810	0.1120	6,686	0.005252
0.0641	0.2500	0.0810	0.2645	19,337	0.015187
0.0641	0.3120	0.0810	0.3270	24,397	0.019161
0.0660	0.1540	0.0830	0.1675	11,874	0.009326
0.0670	0.1120	0.0840	0.1250	8,487	0.006666
0.0670	0.1250	0.0840	0.1383	9,596	0.007537
0.0680	0.0910	0.0850	0.1080	6,812	0.005350
0.0680	0.1800	0.0850	0.1938	14,518	0.011402
0.0680	0.4000	0.0850	0.4150	33,565	0.026362
0.0700	0.2500	0.0870	0.2645	21,215	0.016662
0.0700	0.2650	0.0870	0.2798	22,552	0.017712
0.0720	0.1300	0.0890	0.1433	10,851	0.008522
0.0720	0.1500	0.0890	0.1635	12,684	0.009962
0.0720	0.2100	0.0890	0.2240	18,184	0.014282
0.0720	0.3150	0.0890	0.3300	27,810	0.021842
0.0740	0.2050	0.0910	0.2190	18,248	0.014332
0.0760	0.1340	0.0930	0.1473	11,900	0.009346
0.0780	0.1550	0.0950	0.1685	14,326	0.011252
0.0790	0.1250	0.0960	0.1383	11,506	0.009037
0.0808	0.1080	0.0978	0.1250	10,043	0.007888
0.0808	0.1150	0.0978	0.1323	10,764	0.008454
0.0808	0.1500	0.0978	0.1635	14,365	0.011282
0.0808	0.1750	0.0978	0.1888	16,937	0.013302
0.0808	0.2000	0.0978	0.2140	19,509	0.015322
0.0808	0.2500	0.0978	0.2645	24,653	0.019362
0.0808	0.5000	0.0978	0.5150	50,372	0.039562
0.0830	0.1450	0.1000	0.1585	14,256	0.011197
0.0830	0.1810	0.1000	0.1948	18,061	0.014185
0.0840	0.1180	0.1010	0.1353	11,553	0.009074
0.0840	0.3000	0.1010	0.3150	31,019	0.024362
0.0840	0.3600	0.1010	0.3750	37,436	0.029402
0.0850	0.1520	0.1020	0.1655	15,383	0.012082
0.0850	0.1950	0.1020	0.2090	20,037	0.015737
0.0880	0.4370	0.1050	0.4533	47,897	0.037618
0.0920	0.1540	0.1090	0.1675	16,972	0.013330
0.0940	0.3150	0.1110	0.3300	36,634	0.028772
0.0960	0.2050	0.1130	0.2190	23,990	0.018842
0.0960	0.4500	0.1130	0.4650	53,937	0.042362
0.0980	0.1300	0.1150	0.1473	15,154	0.011902
0.1000	0.3150	0.1170	0.3300	39,040	0.030662
0.1020	0.1320	0.1190	0.1493	16,076	0.012626
0.1020	0.1750	0.1190	0.1888	21,660	0.017012
0.1020	0.2050	0.1190	0.2190	25,556	0.020072
0.1020	0.2700	0.1190	0.2840	33,998	0.026702
0.1060	0.2420	0.1230	0.2560	31,594	0.024814
0.1060	0.2860	0.1230	0.3000	37,533	0.029478
0.1080	0.1150	0.1250	0.1320	14,747	0.011582
0.1100	0.1880	0.1270	0.2020	25,264	0.019842
0.1140	0.1440	0.1313	0.1610	19,835	0.015578
0.1140	0.4120	0.1313	0.4270	58,735	0.046130
0.1160	0.3350	0.1333	0.3500	48,411	0.038022
0.1160	0.3500	0.1333	0.3650	50,627	0.039762
0.1200	0.2200	0.1334	0.2340	32,546	0.025562
0.1230	0.4650	0.1403	0.4800	71,756	0.056357
0.1290	0.1750	0.1493	0.1950	27,676	0.021737
0.1290	0.2100	0.1493	0.2270	33,425	0.026252
0.1290	0.2500	0.1493	0.2670	39,995	0.031412
0.1290	0.3200	0.1493	0.3380	51,492	0.040442
0.1290	0.4120	0.1493	0.4300	66,603	0.052310
0.1440	0.3000	0.1645	0.3180	53,937	0.042362
0.1460	0.1860	0.1665	0.2060	33,509	0.026318
0.1560	0.3120	0.1768	0.3300	61,103	0.047990
0.1620	0.2500	0.1845	0.2690	50,499	0.039662
0.1820	0.2900	0.2068	0.3120	64,800	0.050894
0.2040	0.2700	0.2290	0.2950	67,728	0.053194
0.2040	0.3200	0.2290	0.3420	80,715	0.063394
0.2150	0.2350	0.2403	0.2600	61,929	0.048639
0.2290	0.3000	0.2543	0.3260	85,070	0.066814
0.2580	0.3650	0.2835	0.3910	115,631	0.090817
0.2700	0.2830	0.2958	0.3080	93,018	0.073057
0.2890	0.3100	0.3150	0.3360	109,800	0.086237
0.3000	0.4000	0.3260	0.4260	148,519	0.116647
0.3000	0.5000	0.3260	0.5220	186,716	0.146647
0.3250	0.3500	0.3513	0.3760	140,561	0.110397

TABLE IV—CROSS-SECTIONAL AREA OF BARE COPPER STRAPS AND BARS*

Size, Inches Thickness	Size, Inches Width	Area in Square Inches
0.0100	3/4	0.007479
0.0126	0.300	0.003746
0.0126	0.350	0.004376
0.0126	1/2	0.006266
0.0126	5/8	0.007841
0.0159	0.300	0.004716
0.0159	3/4	0.005908
0.0190	0.300	0.005693
0.0201	1/2	0.009963
0.0201	5/8	0.014988
0.0201	1	0.020013
0.0201	1 1/4	0.025038
0.0226	0.300	0.006670
0.0226	0.350	0.007800
0.0254	1/2	0.006212
0.0254	0.350	0.008752
0.0254	0.400	0.001002
0.0254	5/8	0.012561
0.0254	1	0.025261
0.0254	1 1/4	0.037962
0.0285	3/4	0.021201
1/32	3/8	0.011509
1/32	1/2	0.015415
1/32	5/8	0.017368
1/32	3/4	0.019321
1/32	1	0.023227
1/32	1 1/4	0.027134
1/32	1	0.031040
1/32	1 1/4	0.038852
1/32	1 1/2	0.046665
1/32	2	0.062290
1/32	3 1/4	0.097446
0.0320	1/2	0.007780
0.0320	0.350	0.010980
0.0330	0.180	0.005706
0.0359	1/2	0.013186
0.0159	0.400	0.014083
0.0159	5/8	0.022161
0.0159	1 1/4	0.044598
0.0159	1 1/2	0.053573
0.0365	0.300	0.010664
0.0365	0.562	0.020227
0.0365	1 1/4	0.040777
0.0365	1 3/8	0.046479
0.0380	0.350	0.012990
0.0403	0.150	0.005696
0.0403	1/4	0.009726
0.0403	0.400	0.015771
0.0403	5/8	0.024839
0.0403	1 1/2	0.060101
0.0415	1 1/4	0.046318
0.0420	0.300	0.012221
0.0420	3/4	0.031121
0.0430	3/8	0.015728
0.0430	1 3/8	0.054696
3/64	1/2	0.017106
3/64	7/8	0.020036
3/64	3/4	0.022965
3/64	7/8	0.025896
3/64	1	0.028825
3/64	1 1/8	0.034684
3/64	1 1/4	0.040544
3/64	1	0.046403
3/64	1 1/4	0.052263
3/64	1 1/2	0.058122
3/64	1 3/4	0.069840
3/64	1 3/4	0.081559
3/64	2	0.093278
0.0490	0.181	0.008354
0.0508	1/2	0.012146
0.0508	3/4	0.018496
0.0508	1	0.024846
0.0508	1 1/4	0.037546
0.0508	1	0.050246
0.0508	1 1/4	0.075646
0.0508	1 1/2	0.094696
0.0508	2 1/2	0.126446
0.0520	0.300	0.015019
0.0550	0.400	0.021351
0.0550	3/4	0.040601
0.0550	1 1/4	0.057788
0.0580	0.400	0.022478
0.0580	0.860	0.049158
0.0587	1	0.057961
1/16	3/8	0.022599
1/16	0.400	0.024162
1/16	7/8	0.026505
1/16	1/2	0.030411
1/16	5/8	0.038224
1/16	3/4	0.046036
1/16	7/8	0.058498
1/16	1 1/16	0.057755
1/16	1	0.061661
1/16	1 1/4	0.069474
1/16	1 1/2	0.077286
1/16	1 3/4	0.085099
1/16	1 1/2	0.092911
1/16	1 3/4	0.108536
1/16	2	0.124161
1/16	2 1/2	0.131975
1/16	2 1/2	0.139787
1/16	2 1/2	0.155411
1/16	3	0.186662
1/16	5/16	0.010880
1/16	1/4	0.014787
0.070	1/4	0.060198
0.072	0.400	0.027687
0.072	1	0.070887
0.072	1 1/4	0.079888
1/8	1/4	0.018221
1/8	5/16	0.023104
1/8	3/8	0.927987
1/8	7/16	0.032869
1/8	1/2	0.037752
1/8	5/8	0.047518
1/8	3/4	0.057283
1/8	7/8	0.067049
1/8	1	0.076815
1/8	1 1/8	0.086580
1/8	1 1/4	0.096346
1/8	1 1/4	0.115877
1/8	2	0.154940
0.0808	0.150	0.010719
0.0840	0.300	0.023685
0.0860	0.615	0.051303
5/32	3/8	0.033271
5/32	7/16	0.039129
5/32	1/2	0.044988
5/32	5/8	0.056707
5/32	3/4	0.068426
5/32	1	0.080145
5/32	1	0.091863
5/32	1 1/8	0.103582
5/32	1 1/4	0.115301
5/32	1 1/4	0.127020
5/32	1 1/4	0.138738
5/32	1 1/4	0.162176
5/32	2	0.185613
5/32	2 1/2	0.197332
5/32	2 1/2	0.220770
5/32	2 1/2	0.232488
0.100	1/4	0.022854
0.100	3/8	0.035354
0.100	7/16	0.041604
0.100	1/2	0.047854
0.100	5/8	0.060354
0.100	3/4	0.072854
0.100	1	0.085354
0.100	1 1/4	0.185354
0.100	2 1/2	0.235354
3/16	1/2	0.039129
3/16	5/8	0.052120
3/16	7/16	0.058956
3/16	1/2	0.065792
3/16	5/8	0.079464
3/16	3/4	0.093136
3/16	1	0.106807
3/16	1 1/4	0.134151
3/16	1 1/2	0.161495
3/16	1 1/2	0.188839
3/16	2	0.216183
0.118	0.690	0.078432
1/4	1/4	0.029364
1/4	3/8	0.044988
1/4	7/16	0.042801
1/4	1/2	0.059146
1/4	7/16	0.066959
1/4	1/2	0.074771
1/4	5/8	0.090396
1/4	3/4	0.106021
0.900	0.109146	
1/4	1	0.121646
1/4	1 1/8	0.137272
1/4	1 1/4	0.152896
1/4	1 1/4	0.168521
1/4	1 1/2	0.184146
1/4	1 1/2	0.199771
1/4	1 1/2	0.215396
1/4	2	0.246646
1/4	2 1/2	0.277897
1/4	2 1/2	0.309146
1/4	3	0.371647
5/16	1/2	0.068426
5/16	5/8	0.083647
5/16	3/4	0.118803
5/16	1 1/4	0.153959
3/32	1/2	0.056707
3/32	5/8	0.076238
3/32	3/4	0.095770
3/32	1	0.113834
3/32	1	0.133366
3/32	1	0.152806
3/32	1 1/4	0.191959
3/32	1 1/2	0.211491
3/32	1 1/2	0.231021
3/32	1 1/2	0.250553
3/32	1 3/4	0.270084
3/32	2	0.309146
3/32	2 1/4	0.348209
0.200	0.900	0.176647
0.229	0.300	0.065914
0.300	0.400	0.118113
1/8	1/2	0.068426
1/8	5/8	0.091836
1/8	7/8	0.103582
1/8	1	0.115301
1/8	1	0.137271
1/8	1	0.160709
1/8	1	0.184146
1/8	1 1/4	0.207584
1/8	1 1/4	0.231021
1/8	1 1/4	0.254459
1/8	1 1/2	0.277896
1/8	1 1/2	0.301334
1/8	1 1/2	0.324771
1/8	2	0.371646
1/8	2 1/2	0.418521
1/8	2 1/2	0.465396
1/8	2 1/2	0.488834
1/8	2 1/2	0.512271
1/8	3	0.559146
1/8	3 1/2	0.652896
7/32	3/8	0.080145
7/32	1/2	0.107488
7/32	7/8	0.121161
7/32	1	0.133365
7/32	1	0.160709
7/32	1	0.188053
7/32	1	0.215396
7/32	1 1/2	0.270084
7/32	1 1/2	0.324771
1/4	3/8	0.091863
1/4	1/2	0.123113
1/4	7/8	0.138738
1/4	1	0.152896
1/4	1	0.184146
1/4	1	0.215396
1/4	1	0.242455
1/4	1 1/2	0.273705
1/4	1 1/2	0.304955
1/4	1 1/2	0.320580
1/4	1 1/2	0.367455
1/4	1 1/2	0.429955
1/4	1 1/2	0.461205
1/4	2	0.492455
1/4	2 1/2	0.554955
1/4	2 1/2	0.617455
1/4	3	0.742455
1/4	4	0.992455
1/4	5	1.221250
9/32	1/4	0.138738
9/32	1/2	0.242738
5/16	3/8	0.138738
5/16	1/2	0.154363
5/16	5/8	0.191959
5/16	3/4	0.226830
5/16	1	0.304955
5/16	1 1/2	0.383080
5/16	1 1/2	0.461205
5/16	1 1/2	0.539330
5/16	2	0.617455
5/16	2 1/2	0.773705
5/16	3 1/2	1.203390
11/32	3/8	0.138738
11/32	1/2	0.184146
11/32	1/2	0.231021
11/32	1/2	0.273705
11/32	5/8	0.320580
11/32	1	0.367455
11/32	1 1/2	0.461205
11/32	1 1/2	0.554955
11/32	2	0.742455
11/32	2 1/2	0.836205
11/32	2 1/2	0.929955
11/32	3	1.11745*
11/32	4	1.49245*
11/32	7/8	0.347924
7/16	1	0.429955
7/16	1 1/4	0.758080
11/32	3/8	0.299087
11/32	1	0.486587
11/32	1 1/2	0.611587
11/32	1 1/2	0.736587
11/32	2	0.986587
11/32	3	1.48659
7/16	1 1/4	0.970962
11/32	2	1.23659
11/32	1	0.736587
11/32	2 1/4	1.65773
11/32	2 1/2	3.07135

* Circ.mils = 0.0000007854 sq.in.

TABLE V—DIAMETER AND AREA OF ROUND AND SQUARE COPPER WIRE WITH VARIOUS INSULATIONS

*(Blackface type means square wire)

Gage No. B & S	Maximum Diameter: Bare	S.C.C.	D.C.C.	T.C.C.	Area of Copper: Circ.mils	Square Inches
***4/0**	**0.460**	.....	**0.483**	**0.492**	**265,152**	**0.20825**
4/0	0.460	.....	0.478	0.487	211,600	0.16619
***3/0**	**0.410**	.....	**0.433**	**0.442**	**209,345**	**0.16442**
3/0	0.410	.....	0.428	0.437	167,800	0.13179
***2/0**	**0.365**	.....	**0.388**	**0.397**	**165,037**	**0.12972**
2/0	0.365	.....	0.383	0.392	133,100	0.10454
*** 0**	**0.325**	.....	**0.348**	**0.357**	**130,124**	**0.10220**
0	0.325	.....	0.343	0.352	105,500	0.08286
*** 1**	**0.289**	.....	**0.312**	**0.321**	**102,292**	**0.08034**
1	0.289	.....	0.307	0.316	83,690	0.06573
*** 2**	**0.258**	.....	**0.281**	**0.290**	**80,203**	**0.06300**
2	0.258	.....	0.276	0.285	66,370	0.05213
*** 3**	**0.229**	.....	**0.252**	**0.261**	**62,732**	**0.04927**
3	0.229	.....	0.247	0.256	52,630	0.04134
*** 4**	**0.204**	.....	**0.227**	**0.236**	**50,737**	**0.03985**
4	0.204	.....	0.222	0.231	41,740	0.03278
*** 5**	**0.182**	.....	**0.205**	**0.214**	**39,725**	**0.03120**
5	0.182	.....	0.200	0.209	33,100	0.02600
*** 6**	**0.162**	.....	**0.183**	**0.191**	**32,340**	**0.02540**
6	0.162	.....	0.178	0.186	26,250	0.02062
*** 7**	**0.144**	.....	**0.163**	**0.171**	**25,439**	**0.01998**
7	0.144	.....	0.160	0.168	20,820	0.01635
*** 8**	**0.129**	.....	**0.146**	**0.153**	**19,951**	**0.01567**
8	0.129	.....	0.143	0.150	16,510	0.01297
*** 9**	**0.114**	.....	**0.129**	**0.135**	**16,221**	**0.01028**
9	0.114	.....	0.126	0.132	13,090	**0.01274**
*** 10**	**0.102**	.....	**0.115**	**0.120**	**12,783**	**0.01004**
10	0.102	0.107	0.112	0.117	10,380	0.00815
*** 11**	**0.0907**	.....	**0.103**	**0.108**	**10,033**	**0.00788**
11	0.0907	0.096	0.101	0.106	8,234	0.00647

Gage No. B & S	Maximum Diameter: Bare	S.C.C.	D.C.C.	T.C.C.	Enamel	S.C.C. Enamel	D.C.C. Enamel	S.SilkC. Enamel	Area of Copper: Circ.mils	Square Inches
***12**	**0.0808**	**0.093**	**0.093**	**0.098**	.....	.....	.....	.....	**7,868**	**0.00618**
12	0.0808	0.086	0.091	0.096	0.0832	0.08825	.....	.....	6,530	0.00513
***13**	**0.0720**	.....	**0.083**	**0.088**	.....	.....	.....	.....	**6,162**	**0.00484**
13	0.0720	0.077	0.081	0.086	0.0743	0.07925	.....	.....	5,178	0.00407
14	0.0641	0.069	0.073	0.078	0.0663	0.07125	.....	.....	4,107	0.00323
15	0.0571	0.062	0.066	0.071	0.0593	0.06425	0.0683	.....	3,257	0.00256
16	0.0508	0.056	0.060	0.065	0.0529	0.05775	0.0620	.....	2,583	0.00203
17	0.0453	0.050	0.054	0.059	0.0472	0.05225	0.0563	.....	2,048	0.00161
18	0.0403	0.045	0.049	0.054	0.0422	0.04725	0.0513	.....	1,624	0.00128
19	0.0359	0.041	0.045	0.050	0.0377	0.04275	0.0468	.....	1,288	0.00101
20	0.0320	0.037	0.041	0.046	0.0338	0.03875	0.0428	.....	1,022	0.00080
21	0.0285	0.033	0.038	0.043	0.0302	0.03525	0.0393	.....	810.1	0.00064
22	0.0254	0.0305	0.035	0.039	0.0271	0.03225	0.0360	.....	642.4	0.00050
23	0.02260	0.029	0.032	0.037	0.0242	0.02900	0.0333	.....	509.5	0.00040
24	0.0201	0.025	0.029	0.034	0.0216	0.02650	0.0305	.....	404.0	0.00032
25	0.0179	0.023	0.027	0.032	0.0193	0.02450	0.0283	.....	320.4	0.00025
26	0.0159	0.020	0.025	0.030	0.0172	0.02225	0.0263	.....	254.1	0.00020
27	0.0142	0.018	0.023	0.028	0.0155	0.02025	0.0245	0.0173	201.5	0.00016
28	0.0126	0.016	0.022	0.027	0.0139	0.01875	.....	0.0155	159.8	0.00013
29	0.0113	0.014	0.020	0.025	0.0125	0.01750	.....	0.0143	126.7	0.00010
30	0.0100	0.013	0.019	0.024	0.0111	0.01600	.....	0.0130	100.5	0.000079
31	0.0089	0.011	0.018	0.023	0.0100	0.91500	.....	0.0120	79.70	0.000063
32	0.0080	0.010	0.017	0.022	0.0090	0.01400	.....	0.0110	63.21	0.000050
33	0.0071	0.009	0.016	.....	0.0080	0.01325	.....	0.0098	50.13	0.000039
34	0.0063	0.008	.....	.....	0.0072	0.01225	.....	0.0090	39.75	0.000031
35	0.0056	0.007	.....	.....	0.0064	0.01150	.....	0.0083	31.52	0.000025
36	0.0050	0.006	.....	.....	0.0058	0.01100	.....	.....	25.00	.000020
37	0.0045	0.006	.....	.....	0.0052	.....	.....	.....	19.83	0.000016
38	0.0040	0.005	.....	.....	0.0046	.....	.....	.....	15.72	0.000012

S.C.C. = single-cotton-covered; D.C.C. = double-cotton-covered; T.C.C. = triple-cotton-covered; S.SilkC. = single-silk-covered.

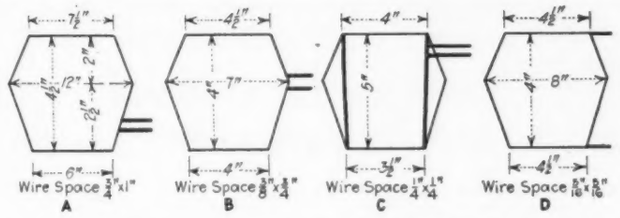


FIG. 2—METHOD OF FILLING IN DIAGRAMS FOR MUSH COILS (C FIG. 1)

Note how the position of the leads is indicated (heavy lines). A is a basket mush coil. C and D are bipolar coils. In C two vertical lines have been added, showing that the coil ends are straight instead of diamond-pointed.

cards can be run off on a duplicating machine or can be printed at a small cost.

On the reverse side of the card are shown the coil dimensions. Only two forms of diagrams are used, one for mush coils (C, Fig. 1) and one for puller coils (D, Fig. 1). These are printed on the cards as desired by means of rubber stamps. If the work is done by a printer the diagrams might be printed from cuts.

The method of filling out the diagram for mush coils is seen in Fig. 2. It will be seen that the position of the leads is indicated by the heavy lines added to the diagram. In *C* two vertical lines have been added, showing that the coil ends are straight instead of diamond-pointed. By such slight modification one diagram is applied to any mush coil.

Information on the puller coil is more complicated. In the diagram (D, Fig. 1) the notations "Leads on top," "on bottom," "at diamond point," "at cells," are used to indicate the position of the coil leads. The top of a coil is that part farthest from the shaft on a rotor and closest to the shaft on a stator (see d, Fig. 3). The terms *B* and *HT* in the next line refer to the width and height of the puller coil as shown at (b), Fig. 3. *RH* and *LH* mean right hand and left hand respectively. One of these pairs of terms is crossed out when the card is being filled.

The difference between right-hand and left-hand coils should be studied carefully. Using a left-hand coil in place of a right-hand in a direct-current wave-wound armature would reverse the direction of rotation in a motor or the polarity in a generator, and would cause other troubles in compensated interpole machines. Fig. 4 shows a right-hand and a left-hand coil. To determine the kind of coil hold it as it would fit in a rotor with the leads toward the observer. If the high side (the side that would fall in the top of the slot) is to the right it is a right-hand coil (*A* in Fig. 4). The reverse holds for a left-hand coil (*B*, Fig. 4). When winding a right-hand coil in a shuttle the groove for the starting lead should be on the left-hand side of the shuttle. For a left-hand coil the groove should be at the right.

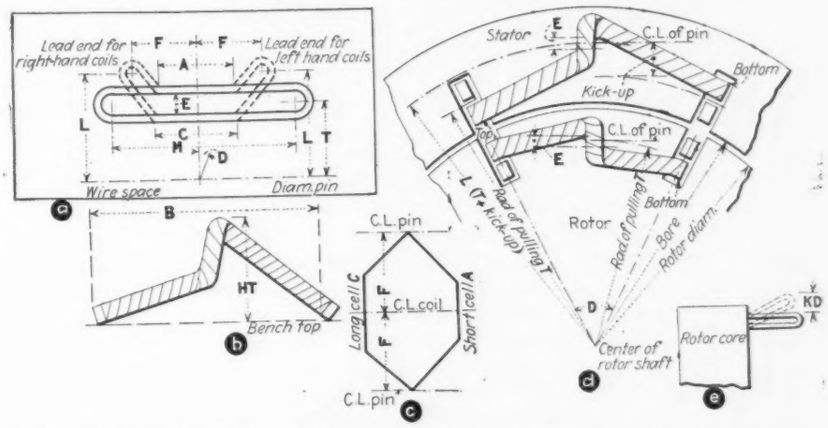


FIG. 3—HOW DIMENSIONS OF COILS IN A MOTOR ARE ENTERED ON CARD DIAGRAM (D FIG. 1)

(a) Is card diagram filled in. (d) Dimension letters to correspond to card at (a). (b) Shows how height of coil (HT) is measured. (c) Shows how length of coil is figured. (e) "Kickdown" of rotor coil is shown at *KD*. The dotted lines in (e) show the coil as pulled and the full lines show the coil with a correct "kick-down" so that the coil ends are below the level of the rotor iron.

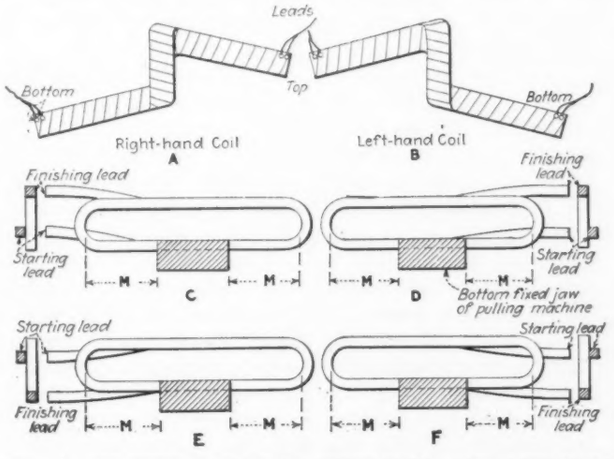


FIG. 4—DIFFERENCE BETWEEN RIGHT-HAND AND LEFT-HAND COILS

A—Right-hand coil, because when leads are toward observer right-hand side of coil would be in top of slot of a rotor. B is a left-hand coil because the left side of the coil would fall in the top of the slot when leads are toward observer. C—Position for pulling right-hand stator coils. D—Pulling position for left-hand stator coils. E—Position for induction-motor, wound-rotor right-hand coils. F—Position for induction-motor, wound-rotor left-hand coils.

At (a), Fig. 3, a puller-coil diagram is shown lettered to correspond with the cross-section of a motor at *d*. All dimensions are obtained from the motor and a sample coil. The length *A* is the length of the slot section of the coil. *B* is the distance from the center line of the bottom of the top half of the coil to the center line of the upper part of the bottom half of the coil. It is more easily measured as at (b) in Fig. 3. *D* is the angle to which the coil is pulled and is equal to (360 deg./*N*) $\times$ coil pitch, where *N* is the total number of slots in the machine. The total inside length of the shuttle is $M + E$, where *E* is the diameter of pins used on the shuttle. *T* is the distance from the rotor-shaft center to the center of the slot. To get *T* for a rotor subtract one-half the depth of the slot from the radius of the rotor. For a stator add one-half the slot depth to the radius of the stator. The dotted line in the card diagram represents the coil pulled to its final shape with the "kick-up" put in the coil. This "kick-up" is put in a stator coil so that the ends of the coil will not project above the level of the stator iron and rub on the rotor or prevent its being put into place. The dimension *L* is best determined by winding a trial coil, placing it in the stator and noting the amount of "kick-up" necessary to make the coil ends come below the iron. This

TABLE VI—NUMBER OF WIRES OF ONE SIZE WHICH IS EQUIVALENT TO A CERTAIN NUMBER OF WIRES OF ANOTHER SIZE

Wire sizes (B. & S. gage) are on top line. In body of table figures on the same horizontal line show the number of wires of each gage equivalent in cross-section. Column on left shows the wire size which is equivalent to the number of wires indicated in body of table under the respective gage sizes in top line.

Size of wire (B. & S. gage), one of which is equivalent to number of wires on same horizontal line to right.

	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	0
0000	2,105	1,670	1,324	1,050	833	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	2
000	1,670	1,324	1,050	833	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3	
00	1,324	1,050	833	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		
0	1,050	833	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2	1
1	833	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2		
2	661	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			
3	524	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1	
4	415	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1		
5	329	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1			
6	261	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1				
7	207	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1					
8	164	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1						
9	130	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1							
10	103	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1								
11	82	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1									
12	65	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1										
13	52	41	32	26	20	16	13	10	8	6	5	4	3		2			1											
14	41	32	26	20	16	13	10	8	6	5	4	3		2			1												
15	32	26	20	16	13	10	8	6	5	4	3		2			1													
16	26	20	16	13	10	8	6	5	4	3		2			1														
17	20	16	13	10	8	6	5	4	3		2			1															
18	16	13	10	8	6	5	4	3		2			1																
19	13	10	8	6	5	4	3		2			1																	
20	10	8	6	5	4	3		2			1																		
21	8	6	5	4		3	2			1																			
22	6	5	4		3	2			1																				
23	5	4		3	2			1																					
24	4		3	2			1																						

Obtained from the Rome Wire Company.

amount of "kick-up" is given to the coil, and it is tried again. For rotor coils a "kick-down" is often required; *i.e.*, when the distance between the rotor iron and the top of the coil is less than $\frac{1}{8}$ in. The lettering on either side of diagram a in Fig. 3 and the sketches *C*, *D*, *E* and *F*, Fig. 4, explain the way the loops should be put in the pulling machine for right-hand or left-hand coils. *A* and *C*, Fig. 3 (a), are the slot section (cells) of the coil which fit in the blocks on the pulling machine. As these blocks have ends rounded with $\frac{1}{4}$-in. radius, they are $\frac{1}{2}$ in. longer than the lengths *A* and *C* in (a), Fig. 3. In this diagram *C* is shown longer than *A*, which holds for all stator coils, as *C* will be the top half of the coil. A stator coil is pulled inverted. For a rotor the side *A* will be the top of the coil and should therefore be the longer.

At the bottom of the card is a notation, "Wire Space," which tells what size to make the slots on shuttles and the space in the jaws of the pulling machine. In figuring this size the wire-space table (Table II) will save time. This table shows the width of slot necessary for any number of double-cotton-covered round wires up to twelve. For instance, with a coil of No. 8 gage wire, two wide by three deep, under No. 8 in the top row and in line with 2 of the first column is the figure $\frac{21}{32}$, which is the width in inches of the coil. Similarly $\frac{11}{16}$ in. is the height. Table III likewise may be used for double-cotton-covered copper ribbon, Table IV for bare strap copper and Table V for square and round with cotton, enamel and silk insulation. These tables give also the cross-sectional area of the wires. Table VI is used for finding wires of equivalent cross-section when the wire size is changed or for substituting when out of stock, etc. For instance, suppose two No. 10 wires may be replaced by wires of other sizes. To find how many No. 14 wires should be used in place of two No. 10 trace down from 10 in the top line to figure 2. Then follow to the left until under 14 is found figure 5. This means that five No. 14 wires may be substituted. Similarly four No. 13 might be used or one No. 7, depending upon the slot space and the formation of the wire in the slot.

To check the new coils against the old coils the dimension *F-F* in (a) and (c), Fig. 3, and the dimensions *B* and *HT* in (b) and (d), Fig. 3, are used. *F* is the distance between the center lines of the shuttle pins and of the coil when pulled to shape. This is a check on the coil length, and the total inside length of the coil is $E + 2F$. *B* is a check on the angle *D* or the coil pitch. This is measured as shown in (b) and (d), Fig. 3. *HT* is the height of the coil at the diamond point from the bench on which the coil lies as in (b), Fig. 3.

When filling out the coil-order cards a requisition for material should be made at the same time, the necessary data being obtained from a sample coil taken from the motor. A copy of the coil order can be made on plain paper and filed on the "incompleted" file of the shop as a tickler.

Complete instructions on making molds and winding, insulating and pulling coils will be given in a later issue of the ELECTRICAL WORLD.

THE *legislation which took from the municipalities the regulation and control of public utilities and vested the power with the utility commission has been welcomed by the public and the public utility companies alike. But it should not be forgotten that successful regulation must be fearless and fair and accommodated to the exigencies of changing conditions. Whenever the administrative agency appointed to arbitrate the public and the utility is influenced by public sentiment rather than considerations of justice, the purpose of the law will fail, not because of its infirmities but because of its weak and servile administration. Critics should appreciate that private capital devoted to public service is entitled to a fair return and that it requires more courage and character to render just than popular decisions.*—From a decision by Justice Owen of the Wisconsin Supreme Court.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Disturbances from X-Ray and Radio Outfits

To the Editor of the ELECTRICAL WORLD:

SIR: Owing to the increasing use of X-ray and radio equipment, it seems advisable that electric service companies give immediate attention to some of the difficulties of serving such apparatus before the objectionable features become serious obstacles. The objection to the X-ray machine is that a large transformer capacity is required with but little return for the service rendered. The actual use of the equipment takes relatively large capacity and but little energy, so that if charges are made for the energy consumption only, the return is not commensurate with the investment required to serve; in fact, the losses in the transformer will in most cases exceed the consumption of the equipment in use.

To meet this situation the central-station company must necessarily make a demand or readiness-to-serve charge adequate to compensate for the carrying charges on the excess transformer capacity required and the losses through the transformer itself.

With radio outfits there is actual disturbance to the service of other consumers. We have had a number of actual cases, the experience in a few of them being as follows:

Case (a).—A radio outfit was installed in a high school with some patented device for preventing "kick-back." The device did not perform the function for which it was intended and the disturbances were transmitted to other consumers supplied from the same transformer, resulting in the burning off of wires in the house and actual sparking from lighting fixtures.

Case (b).—An outfit was installed in the laboratory of one of the colleges supplied by us which when put in use caused a flickering in the lights on all of the service supplied from the same transformer. There was enough disturbance to cause a jumping of the current from the service wires to the steam pipes in the building in which the installation had been placed to such an extent that a person able to do so could read the messages being sent out when sitting in the room in which the jumping occurred.

Case (c).—A wireless outfit was installed by one of our consumers in a shed, with a separate service line direct from the distribution transformer. As soon as this set was placed in service adjacent consumers commenced to complain of serious flickering of the lights, which continued until the set was placed on a separate transformer.

These three cases are typical of the effect of wireless outfits, and at the time they were first observed we notified the consumers that it would be necessary for them to install independent transformers from the primary distributing voltage to 110 volts, or to install 1-kw. one-to-one transformers on the service lines.

Informal complaints were made by two of these consumers to the commission, and the chief of Bureau of Rates and Tariffs of the commission, in the correspondence concerning these informal complaints, advised us that in his opinion:

"It is incumbent upon the electric company to supply service for these radio plants, and it would also appear that the investment in the transformer should be made by the electric company. . . . If the cost of supplying this equipment is such that it would be unfair to other consumers to absorb that expense in the general operating expenses, it would appear logical that a rate might be made especially for service to radio apparatus."

Acting on this advice from the chief of bureau, we amended two of our rates to provide for service to X-ray machines and radio outfits—one when the service is supplied under a domestic schedule and the other when it is under power schedule. These schedules have a minimum based upon the connected load, and the schedules state:

"X-ray machines, wireless outfits or other apparatus of highly fluctuating load characteristics will be included in the connected load at their full load requirements. If it is necessary for producer to install excess transforming capacity or an individual transformer to prevent detrimental effect of such apparatus upon service to other consumers, the normal rated capacity of transforming equipment so installed will be the measure of the connected load of the apparatus necessitating it."

Under this provision we charge a minimum based on the capacity of the transformer required to absorb the disturbances, thereby obtaining revenue to compensate for the additional investment and losses incurred. This action was taken about a year ago, and since that time all consumers have been paying the minimum charge without complaint and no further trouble has been reported by consumers adjacent to the outfits. So far as experience extends, the separate transformer has been found the only adequate means for absorbing the disturbances.

G. M. GADSBY,
Vice-president.

West Penn Power Company,
Pittsburgh, Pa.

Measuring Speed of Small Motors with Rotating Disk

To the Editor of the ELECTRICAL WORLD:

SIR: The writer was very much interested in the method of determining the speed of small motors by rotating-disk comparison as presented by W. H. Farr in the ELECTRICAL WORLD of May 7. To be sure, this is not a new method and apparently is not so held to be by the author. The exact method of making the comparison and determining the speed of the motor, however, is probably unknown to a great many engineers. A detailed description of the method is therefore of value.

In spite of the author's apparent familiarity with the method and his experience in making speed determinations, certain statements are made which would no doubt lead an inexperienced operator to errors in making speed determinations. For instance, the author states that with an arrangement as shown in the illustration (one spot on pulley of motor and four slots in rotating disk) "when a synchronous speed has been reached only one spot is seen, and it is apparently standing still." He further states in the same example that the speed of the

disk multiplied by the number of slots in the disk gives the speed of the motor under test. It can be readily shown that these statements are incongruous.

Assume the motor and disk synchronized, the motor rotating at four times the speed of the disk. Suppose the spot on the pulley is directly back of a slot at some given position. If the motor is running at four times the speed of the disk, the spot on the pulley will overtake the next slot in the disk at some point having an angular distance from the first position which we will call x. While the spot on the motor was reaching this point the slot in the disk traveled an angular distance of $x/4$, since its speed was assumed to be one-fourth of the speed of the motor. But this slot in the disk was already 90 deg. from the first position at which the spot was visible. We, therefore, have the equation $x = 90$ deg. $+ x/4$, and $x = 120$ deg. Similarly, the next point at which the spot is visible is 120 deg from this point, and thus it is seen that there are visible three apparently stationary spots at the time of exact synchronism. By means of similar calculations it can be shown that if the disk is rotated at one-half the speed of the motor two stationary spots will be visible, and if it is rotated at three-fourths the speed of the motor only one spot will be visible.

In order to obtain a solution for all problems of this nature an equation has been derived which is of general application. Let N = the number of slots in the disk; R = the ratio of speed of motor to speed of disk, and x = the angular distance between successive appearances of the spot. Then $x = \frac{360\ R}{N\ (R-1)}$. If x is 360 deg., or an aliquot part of 360 deg., then there will be one or more stationary spots.

ALVA G. HUSTED,
Assistant Engineer.

Department of Public Service,
Cleveland, Ohio.

Refilling Inclosed Fuses

To the Editor of the ELECTRICAL WORLD:

SIR: My article on "Refilling Inclosed Fuses" in the ELECTRICAL WORLD for April 9, page 829, was certainly not intended to upset any recognized standard practice, nor was its purpose to cause the use of *any* size of fuse instead of the proper one. An old fuse properly refilled is far safer in emergencies than exposed wire solder or copper or iron wire, such as is sometimes used to keep a motor or circuit working.

An instance came to my attention not long ago where a company had no fewer than 500 blown-out fuses of various sizes up to 60 amp. and was hopelessly short of the new ones needed to operate some motors carrying very unsteady loads, such as electric tractors, iron-pot crushers, foundry-sand cutters and cranes. Wire of all sorts, and even pieces of iron, were used by the men to get along. The manufacturer of the fuses was asked to refill them but refused to fill any under 65 amp. As many of the fuses were needed for immediate use, the idea of refilling some with tested fuse wire was tried.

When a motor rated at 40 amp. draws close to 100 amp. to get its load started, a fuse of any smaller size does not stay on the job very long, and as the larger size is needed to start things going, there is no protection while running under normal loads. Thus the fuse in this case is little save an ornament. Here is a pot crusher in a foundry doing splendid work with a 15-hp. motor rated at 27 amp. per terminal on 440 volts, but for one critical moment it requires 40 amp. to break a casting in two. The motor has a rating of 25 per cent overload for two hours, but even 50 per cent or more overload for one or two minutes does absolutely no harm to it. No fire risk is present so long as the line installed is made extra heavy to care for sudden overloads. This motor would not operate three minutes with 35-amp. fuses, so 40-amp. fuses were used. Even the 50-amp. size were blown repeatedly, much to the disgust of the operator; yet the motor is large enough for 90 per cent of the castings broken up. In the running of this motor the last of many fuses in stock is sometimes used up, and to finish the work the old ones are often refilled in a hasty manner and used again.

The writer mentioned that the refilling of fuses was generally condemned; but where something has to be used immediately, in the absence of new fuses, the old ones refilled as near to their rating as possible under conditions of haste cause no worrisome risk. It is evident to every one that there is no need of renewing fuses when time and quick transportation permit of new ones being kept in stock; but when shipments are delayed for one or two months in transit and even get lost entirely, the safest makeshift is not a bad substitute to keep the wheels moving. Furthermore, when hot iron is flowing and molders yelling like Indians for the metal refilling a fuse allows the work to go along, whereas an exposed fuse wire of any sort would probably arc in the operator's face or otherwise cause serious trouble.

Of course, this is no defence for using an unapproved refilled fuse, but when a hard-working motor fails to function right in the middle of a hurried performance, with no good fuses at hand, perhaps in an emergency others would do the very thing that my article mentions and call it the best and safest thing to do under the circumstances. Since the occasion which inspired my article on refilling fuses our New Britain firm has received a quantity of approved fuses and also a goodly number of oil and air circuit breakers, which need no refilling.

H. S. RICH.

Little River, Conn.

The Danish Small Belt as a Source of Hydro-Electric Energy

To the Editor of the ELECTRICAL WORLD:

SIR: Great efforts are at present being made in Denmark to develop the country's natural resources. Denmark produces no coal, and for its fuel supply the country is entirely dependent upon foreign importation.

Some time ago the Danish government appointed a special commission of experts to study the power resources of the country. In a report now submitted the commission advocates the utilization of the water power in the Small Belt. The current in this Danish bay, situated between Jutland and the Funen Island, is extremely strong, and the technical experts of the commission are of the opinion that by means of proper installations a large amount of energy can be rendered available for electrical purposes. The government is seriously considering the expediency of this gigantic project.

HENRY L. GEISSEL.

Beaurivage, Thoune, Switzerland.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Economic Comparison of Three-Wire and Two-Wire Distribution

ALTHOUGH it is known that three-wire has advantages over two-wire distribution, the accompanying table is of interest in that it compares concretely the operating costs of both systems. These figures are for a territory and load requiring either three 5-kva. transformers for a two-wire secondary system or two 7½-kva. transformers for a three-wire system. Calculations show that when a load of 5 kva. or more is to be connected it is practicable to run two two-wire circuits 1,000 ft. each side of the transformer. This is the condition where the cost of interest, depreciation and transformer loss of the transformer installation is equal to the cost of interest, depreciation and copper loss of the two-wire secondary circuit. Moreover, for the same voltage drop at the end of the line it is practicable to run a three-wire system 1,500 ft. or 50 per cent further than a two-wire system, before the operating cost of the three-wire system overbalances the operating cost of the transformer installation. This relation is followed in the tabulation, six two-wire circuits 1,000 ft. long being employed with three 5-kva. transformers and four three-wire circuits 1,500 ft. long with two 7½-kva. transformers. It is seen that the saving in operating expense is $16 per year.

Besides the fact that the larger transformers cost less per kva. rating, their efficiency also is higher. Since a greater territory can be served from each transformer, a greater load can be connected, which will increase the load diversity factor. This in turn permits a saving in transformer capacity, which further decreases the investment in transformers.

COSTS OF THREE-WIRE AND TWO-WIRE DISTRIBUTION LINES COMPARED

Investments:	Two-Wire	Three-Wire
Cost three 5-kva. transformers and installation	$283.65	.....
Cost six two-wire circuits, No. 4 (6,000 ft. total)	415.00	.....
Cost six lightning arresters and grounds	90.00	.....
Cost two 7½-kva. transformers and installation	.....	$242.00
Cost four 3-wire circuits No. 6 (6,000 ft. total)	.....	367.00
Cost four lightning arresters and grounds	.....	60.00
Total	$788.65	$669.80
Saving on three-wire construction	.....	118.85
Yearly operating cost:		
Interest and depreciation, transformers	$45.30	$38.75
Interest and depreciation, copper wire	41.50	36.78
Interest and depreciation, lightning arresters	14.40	9.60
Copper line loss, six circuits	9.00	9.00
Total yearly cost	$110.20	$94.13
Saving per year on three-wire operation	.....	16.07

These two conditions—serving a greater territory and connecting a greater number of services—make it possible to balance the load better across the 220-volt wires. This in turn makes it possible to use a smaller neutral wire, and a further saving in copper is made. In ordinary practice a wire at least one size smaller is used for the neutral wire; and generally where the load can be well balanced it is safe to use a wire two sizes smaller. A saving is also made in the installation of lightning arresters and ground wires.

The only additional cost due to the installation of a three-wire system that could be subtracted from the saving in copper is the cost of the insulators for the neutral wire and the extra time necessary to run the neutral wire. However, this extra cost is almost offset by the advantage of handling the smaller secondary wires.

W. A. DARTER,
Superintendent of Engineering.
Brenham Compress, Oil & Manufacturing Company,
Brenham, Tex.

Local Repairs of Transformer Coils Possible

REPAIRS of high-tension transformer coils that have been damaged in operation has been found profitable by the Consumers' Power Company. The damaged stack is torn down and any coils with badly burned copper or a large percentage of insulation damaged are thrown aside and scrapped. Those with only the outside tape or insulation between turns damaged in spots are sent to the repair shop. All tape is removed, and the coils are scraped or brushed with a stiff brush to remove all carbon and bits of copper. They are then placed in an oven made up of a box lined with asbestos and a heating element made up of No. 9 B. W. gage iron wire, which heats the oven to 80 deg. or 90 deg. C., to dry out the coils thoroughly. They are then straightened and insulation is put between turns at damaged points. Any conductor turns that have been burned are built up with small bits of copper and solder to normal size. The coil is then clamped and taped, after which a heavy coat of General Electric No. 152 clear varnish is applied and the coil is put in the oven to dry. This generally requires from three to six hours, and the operation is repeated four or five times or until the coil is filled between edges of the turns and smooth on the outside. The clamps are removed during the process to allow thorough distribution of the varnish to all parts of the coil. The coil is then retaped, lead supports are put on, and the varnish and baking process is repeated three or four times.

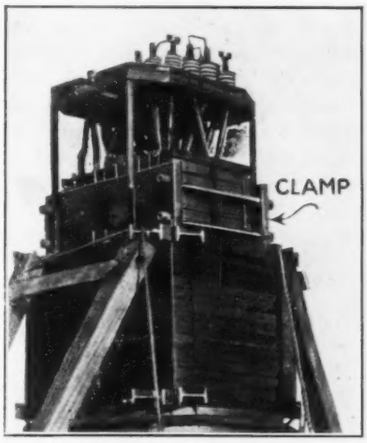


FIG. 1—CLAMPS PREVENT DISTORTION OF COILS

In the older type of transformers considerable difficulty has been encountered with the old form of spacer, which will allow one turn of a coil to buckle over the next on a short circuit. The button spacer (Fig. 2) is substituted in reassembling the stacks.

It has also been found worth while in reassembling

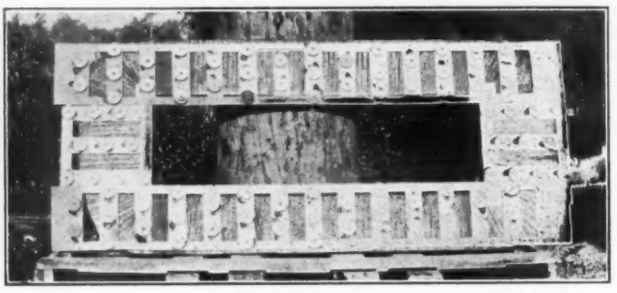


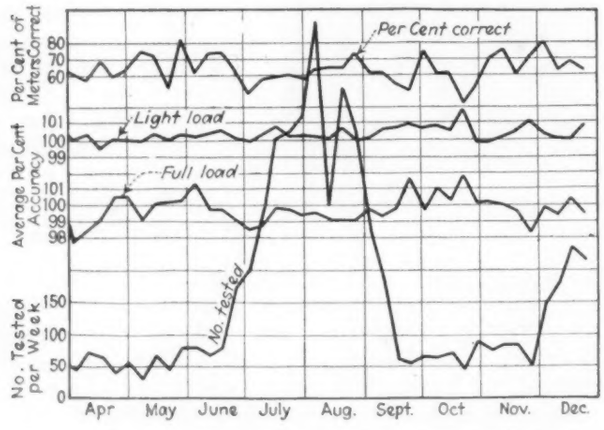
FIG. 2—BUTTON-TYPE SPACER PREVENTS BUCKLING UNDER SHORT-CIRCUIT STRESSES

to use a heavy steel clamp (Fig. 1) on both the top and bottom projections of the coils from the core.

Consumers' Power Company, Battle Creek, Mich. E. O. SLAYBAUGH.

Graphic Diagrams Show Condition of Customer's Meters

TO SHOW whether the accuracy of customers' meters is holding within the required limit between tests, graphic reports are plotted by the Worcester (Mass.) Electric Light Company. The curves on these reports show the percentage of the meters tested which are within the required limits of accuracy, the average accuracy of the meters at light load and at full load, and the total number of meters tested. The curves are kept up to date from week to week. If the number of inaccurate meters increases, this is quickly shown by the chart and the period between tests can be shortened. The large increase in number of meters tested in the summer months as shown by the curve is due to the



CURVES SUCH AS THESE SHOW WHEN METERS ARE BEING TESTED TOO INFREQUENTLY

employment of students who are engaged temporarily by the company for this work.

The distribution department of this company uses curves of this nature for improving operation and management along other lines than meter work (see past issues of the ELECTRICAL WORLD and issues which will be published later). George M. Hardy, superintendent of the company, furnished the diagrams.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

How Oil Should Be Filtered for Horizontal Steam Turbines

THERE are two methods of oil filtration in use with horizontal turbines. One is the batch system, and the other partial filtration with a circulating system. The batch filter is most commonly used. The entire batch of oil is drained from the turbine at stated intervals, preferably every two weeks, and a new batch at once pumped back to the turbine. The filter should have a precipitation compartment large enough to hold the entire batch of the largest turbine. The clean-oil compartment of the filter generally holds more than one batch and may also be used for the storage of new oil. When the batch has been let down into the filter from the turbine it is heated, allowed to stand at perfect rest for a period of time to precipitate its impurities, and then run through the straining medium to the clean-oil compartment.

One batch filter will serve a number of turbines and the oil will be made cleaner at less expense of operation than if partial filtration with circulating systems were used.

It is sometimes not convenient to shut down a large turbine so that the oil can be filtered as often as it should be. In this case a circulating filter is installed that will receive by overflow and return to the turbine a certain percentage of the total batch each hour. What percentage this should be is governed by the kind of oil used, the amount of water that leaks into it, the condition of the bearings, the amount of oil in the turbine, and its rate of circulation to the bearings. The writer believes that if 10 per cent of the batch passes through the filter each hour the oil will be kept in good condition. The oil should be taken from the lowest point in the reservoir and allowed to rise to an overflow sight set to maintain a given level in the turbine before it runs to the filter. From the clean-oil compartment of the filter the oil is pumped back to the turbine reservoir.

It is desirable to add to this system a storage tank large enough to hold the entire batch of oil, so that when the turbine is shut down all of the oil may be run through the filter into the storage tank. The filter should not be required to work to capacity when changing 10 per cent of the oil per hour, but should be large enough to clean the entire quantity of oil in from three to four hours.

The principal reason for turbine-oil filtration is to prevent the formation of an emulsion of oil and water and of sludge. Sludge when passed over the bearings stops up the oil grooves. The heat of the bearings, with the constant circulation of air through the oil, causes a mineral acid known as SO_2 to form, which in turn breaks down the good oil.

If 10 per cent of the contents of the turbine reservoir are removed from the bottom of the reservoir each hour, the oil will not have an opportunity to emulsify under normal conditions, and the breaking down of the oil will be impossible.

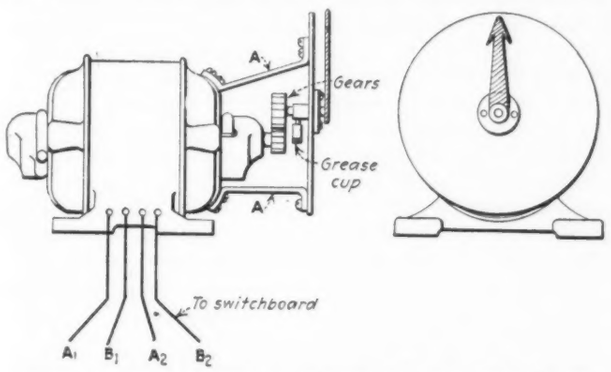
This information was contained in an article by Carver Wood in the *Journal* of the American Society of Lubrication Engineers.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Rotation Indicator for Testing Repaired Compensators

AFTER an auto-starter has been repaired or overhauled it is necessary to see that the phase rotation on the secondary side is the same for both starting and running position. This purpose is accomplished conveniently in a New York repair shop by means of a rotation indicator connected to the switchboard, to which the leads from the auto-starter may be attached. This indicator consists of a dial mounted on top of the switchboard with the hands driven through gears by a slow-speed motor. For this purpose an old ¼-hp. polyphase industrial motor which had been cast aside



DIRECTION OF ROTATION OF PHASES OF AUTO-STARTER IS CHECKED BY ROTATION OF POINTER

was cleaned and rewound for 440 volts, two-phase, 60 cycles, with twenty-four poles which gives a synchronous speed of 300 r.p.m. The rewinding operation of this motor has already been described in the ELECTRICAL WORLD for Oct. 9, 1920, page 741. The motor shaft is fitted with a pinion having sixteen teeth, and this meshes with another pinion having forty-nine teeth mounted on a shaft in the rear of a 12-in. metal disk. The disk is fastened to the motor by means of the brackets shown at *A* in the illustration. A steel bushing fitted into the center of the disk serves as a bearing. Lubrication is accomplished by a grease cup taken from an old fan. A wick is used for lubricating and the cup is packed with vaseline. The indicator shaft extends through the front of the disk approximately ½ in., where a pointer, made up of ⅛-in. sheet brass, is pinned to the shaft. The disk is painted a dull black to serve as a background for the pointer, which is painted with aluminum paint to afford a better observation of the direction of rotation.

Four leads run from the motor to binding posts on the switchboard. The secondary side of the auto-starter is connected to these binding posts. Voltage is put on the auto-starter, and after the handle is thrown to the starting position the direction of rotation of the indicator is noted. The handle is then thrown to the running position and the direction of rotation is again watched. If a reversal of rotation takes place, the leads of the auto-starter are improperly connected and must be changed.

The indicating motor has a two-phase winding with each phase separated from the other. When testing two-phase, four-wire starters, two leads of one phase are connected to A_1 and A_2, and the other two leads to B_1 and B_2. In testing a two-phase, three-wire starter or in testing a three-phase, three-wire starter, the studs marked A_2 and B_1 are tied together. This forms a connection for one phase leg, and the studs A_1 and B_2 serve as the other two legs. The motor may be used on either 220 volts or 440 volts.

This device has proved to be a decided time saver for the tester, as it eliminates the necessity of checking the internal connections. E. R. DEBMAN.

East Orange, N. J.

Safety Standard for Industrial Control Equipment

IN ORDER to study the problem of safety protection the Electrical Safety Conference, which is made up of the United States Bureau of Standards, the Underwriters' Laboratory, the National Workmen's Compensation Service Bureau and the electrical manufacturers, appointed a joint committee. In January, 1921, the Electrical Safety Conference published the proposed safety standards as drawn up by this committee. The proposed standard for industrial control will form part of a more complete standard to be used in conjunction with the National Electrical Safety Code.

The principal hazards may be briefly stated as follows: (1) Touching live parts; (2) arc or flash; (3) touching hot parts; (4) explosion of fuses; (5) gas or dust explosion; (6) injury from moving parts of controllers; (7) phase reversal; (8) unexpected starting; (9) overspeed; (10) lack of emergency stop; (11) overtravel; (12) failure of power; (13) overload. Most of these hazards can be avoided by the proper design and installation of the electrical equipment. The two hazards which most often result in accidents are the touching of live parts and injury from arc or flash.

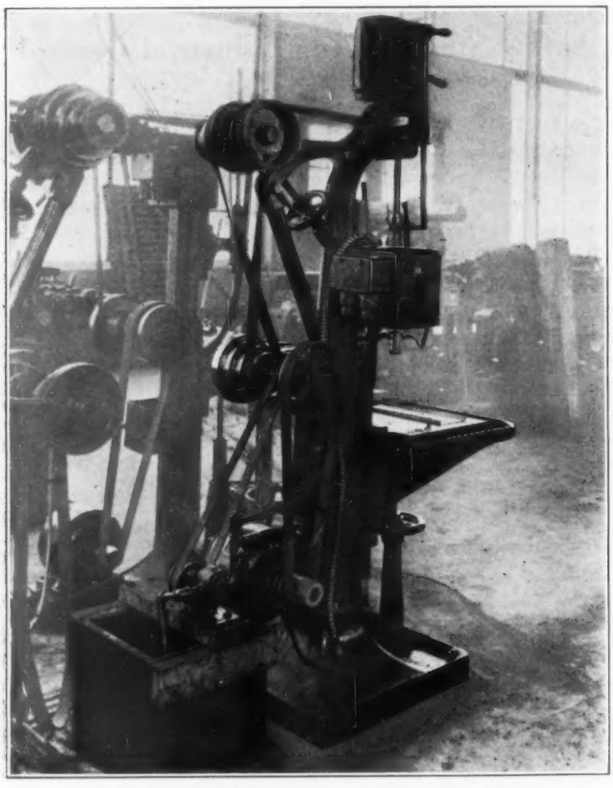
The first six hazards may be guarded against by (1) inclosure, (2) isolation and (3) guarding. Some types of control apparatus such as push-button stations and drum controllers provide the requisite safety features by their construction and are, therefore, independent of the method of installation, provided that the inclosure is grounded. Other control apparatus, such as large contactor panels, often require protection by isolation or guarding. The control equipment should be placed so that it is readily accessible for operation, inspection and repairs. Sufficient working space should be provided about the control equipment to permit its being

readily repaired or adjusted by qualified persons. This space should provide a secure footing and should be large enough to provide freedom of movement without the danger of interference from moving parts of that or other machinery.

The proposed safety code covers the subject in considerable detail and merits the careful attention of all persons interested in the manufacture or use of electrical control equipment. H. D. James, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is chairman of the sub-committee which drafted this standard.

Motor Mounted on Drill Pedestal for Individual Drive

A COMPACT motor mounting for individual drive of a power drill is illustrated in the accompanying photograph, which shows a 1-hp. motor mounted on the rear of the drill pedestal and driving the drill by means of a belt. The motor takes up only the free space between an oil pump and the machine frame. Considering the large number of different speeds required at the drill and pump and the amount of shafting necessary, the drive is particularly compact. The starting switch is mounted upon 1¼-in. x ¼-in. strap-iron pieces bolted to the frame. It is arranged at a convenient height for the left hand of the driller. Connection



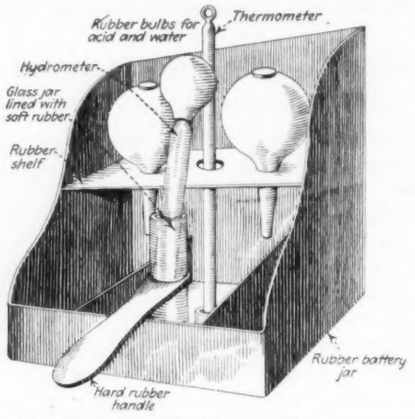
MOTOR MOUNTED ON LOWER PART OF FRAME DRIVES DRILL THROUGH BELT

between the starting box and the motor is made through flexible conduits attached by clips to the drill frame. This installation is at East Springfield, Mass., in the plant of the Westinghouse Electric & Manufacturing Company.

FIELD EDITOR ELECTRICAL WORLD.
Boston, Mass.

Tray for Hydrometer, Thermometer and Syringes Used in Battery Work

AS A HANDY aid in equalizing the specific gravity of batteries, a tray for carrying hydrometer, thermometer and water and acid syringes is used in the vehicle-battery department of the New York Edison Company. The tray is made by cutting away part of the sides of an old hard-rubber battery jar in the manner shown in the accompanying drawing. At the middle of the jar a shelf of hard rubber made from an old jar is mounted. This is cut to fit in a groove on the front edges and has two projecting pieces which are inserted in holes in the back side of the jar to support the shelf. In this shelf are two holes for the syringes, one of which is used for water and the other for acid. Through a third and smaller hole a thermometer is placed. The bottom end of the thermometer rests in a rubber vent cap or nipple such as is employed in the vent hole of a cell. This cap is fastened in place with sealing compound. The hydrometer rests in a glass tube on the bottom of the jar in front of the shelf. This tube is lined with soft rubber to prevent breaking the hydrometer. For convenience in handling, a hard-rubber handle is placed on the tube. The handle is made by cutting a round hole in a length of battery-jar rubber, and the tube is inserted into this hole.



EQUIPMENT FOR EQUALIZING BATTERY ACID CARRIED CONVENIENTLY IN THIS TRAY

When equalizing a battery this tray, a bucket of water and one of acid are placed near at hand. All the necessary pieces are convenient to reach. Hydrometer and thermometer are replaced in their holders instead of being laid on top of the battery, from which they might fall off and break. The tips of the syringes are kept clean.

A. SHEINAUS,
Fore Battery Man, Auto Department.
New York Edison Company,
New York, N. Y.

Wear of Brushes, Commutator and Rings Lessened by Proper Attention

CARE in the operation of motors will be amply repaid by decreased trouble and wear of such parts as brushes, commutator and slip rings. If the commutator is very rough, a few fine turns taken off in a lathe will help exceedingly; but if only slightly rough or dirty, an application of No. 00 sandpaper will improve the surface. If the brushes flash steadily, a close examination of the mica between the bars will probably show an open circuit in the winding.

If a slip ring is quite rough, the indication is that its brush does not make good contact, owing to its being wedged by dirt, to too short a brush or to a weak tension spring. If a brush is excessively hot, it probably

has no pigtail to conduct the current, and this omission will probably heat the spring also and spoil its temper. If the brushes squeak, apply a little vaseline or light oil; but a too generous application of any commutator compound is liable to clog the brushes in the holders.

If necessary to renew any brushes, take time to do the work right; that is, provide a good contact for each brush by drawing fine sandpaper under its surface. When the carbon seems to cut the commutator and makes much noise, a hard graphite brush may give better results if the commutator is very smooth; if rough, the graphite will wear down like chalk.

See that all brushes are free in the holders; renew short ones and clean the dirty ones. Brush tension should not be so strong as to wear out the brushes rapidly and cut the commutator, nor so light as to allow them to spark, but uniform and fairly strong for even wear and good contact. Any missing tension springs should be replaced. With electroplating generators the brushes, being of copper, should have only very slight tension, so as to reduce to the minimum any cutting of the commutator.

Brushes must be staggered in pairs of sets, the first two sets being in line and the next two sets in line with each other but staggered from the first two. This arrangement should be repeated taking in all sets.

East Berlin, Conn. H. S. RICH.

Detachable Platforms Keep Industrial Trucks Working

INTENSIVE study should be made to reduce costs in handling goods between freight stations or piers and warehouses and between the various buildings of large industrial plants, such as steel mills, shipyards, etc. Costs can be decreased by electric trucks designed to run both out of doors and indoors, with separable platforms to be loaded and unloaded while the truck is kept constantly busy hauling.

An example of this method of hauling goods is shown in the accompanying photograph illustrating a truck

PLATFORM LEFT FOR UNLOADING WHILE THE TRUCK MAKES ANOTHER TRIP

and platform used on a New York pier. The empty platform can be left for loading, while the loaded one is taken to the warerooms, where another gang is unloading the platform brought on the previous trip.

FIELD EDITOR ELECTRICAL WORLD.

New York, N. Y.

Electrical Heating of 166 Rivets Cost 1 Mill per Pound

TWO months' experience with electric heating of rivets in this plant has shown notable economies over the old coal-fired furnace method now gradually being superseded on these premises. The best results are being attained by a Berwick rivet heater capable of heating five rivets in multiple at once. This equipment will handle rivets up to 7 in. maximum length, and on a recent run 166 $\frac{3}{4}$-in. x 3$\frac{1}{4}$-in. rivets were heated at an energy cost of 1 mill per pound, the time required for the batch being only forty-five minutes. These were machine-driven rivets and were not heated to so high a temperature as hand-driven rivets. About 60 kw. input is taken by the machine when in service at full load. There are three heats, easily controlled by a switch accessible to the operator, and the average rate for energy purchased is 2.8 cents per kilowatt-hour.

Under present conditions of business it is difficult to determine the best economy of this machine over a considerable period. The figure above given represents the lowest cost attained in a run of which the input was metered carefully, and it may be noted that on another run only sixty hand-driven rivets were heated in seventy-five minutes. An energy cost of 7.8 mills was entailed. This was the maximum required in any run, and the average under present conditions is about 3.5 mills per pound. With a busier shop the demand for rivets naturally increases to a point yielding higher economies in energy consumption. Under pressure of heavy demand, 150 $\frac{3}{4}$-in. x 3$\frac{1}{2}$-in. rivets have been heated in twenty minutes in this machine, and a 5-in. rivet $\frac{7}{8}$ in. in diameter can be heated for driving in fifty seconds. With the four coal-fired heaters formerly used sixteen hours per week, including overtime, was required for their care, and at least one and one-half times a year the furnaces had to be rebricked, the task taking the time of two men for a day, including overtime. Under such conditions the first cost of an electric riveter would be more than covered in its first year's service. The increased comfort to operators in the shop is also a strong point in favor of electric service. In selecting a rivet heater it was found helpful to secure the benefits of multiple rather than series operation, and thus to gain full-speed production under such conditions. In times of light business the facility with which the electrical supply can be controlled and cut off proves of great value in comparison with the expense of maintaining coal fires, which must in large measure be run regardless of the volume of heating demanded.

Eastern Bridge & Structural Co., A. S. MILL,
Worcester, Mass. Master Mechanic.

Protecting Commutators Against Oil

COMMUTATORS exposed to oil or to gas-engine fumes should be protected by double cords on both ends and several coats of baked Sterling varnish. When baking is impossible several air-dried coats of shellac should be used. All parts of the commutator not actually used for brush contact should be varnished, particularly the sections between the tails and at the front corner of the bars.

A commutator that is exposed to oil or fumes should have all of the insulation cleaned off weekly with a damp gasoline rag and should be revarnished at frequent intervals.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Central Maine Power Company Goes After Fan Business

ALTHOUGH it has been said that electric fans will sell themselves, almost, during the months of July and August, the Central Maine Power Company believes that much more profit can be realized by an active campaign in the fan season. Accordingly a plan has been mapped out on this basis: The thing to do is not to waste time telling people that there is such a thing as a fan. They know it already. When it is hot the problem is to convince people that they can afford a fan at home as well as in their place of business. The company placed its advertising matter in the hands of the newspapers, to be released when the first hot wave struck.

To further assist the sales force in pushing the fan business, the company issued the following suggestions as to the principal places where, for hot weather use, fans are sold:

1. Homes.—In addition to the usual argument for greater comfort during the hot days, emphasize the value of the fan on sultry nights. Tell how it makes for restful sleep and greater efficiency, giving the folks at home the same comforts you get in your office. If you can't go away for the summer, bring the cool breezes to your home.

An electric fan brings sleep to helpless infants on sultry nights.

An electric fan will dry the clothes indoors even if it is damp and muggy outside. Fans are particularly useful in kitchens in the summer, to blow the heat and cooking odors out of the window.

2. Stores, Hotels and Restaurants.—In stores fans help preserve perishable stock such as fruits and vegetables, keep candy in better condition and keep flies off all stock. They keep the vitality and "pep" of clerks up to a higher pitch, making them more comfortable and therefore more cheerful.

Fans have been found more effective than the banging screen door. The screen door, while necessary in some stores, is objectionable in that it shuts off the view of the store interior from the street almost as effectively as a solid door. A ceiling fan hung just outside and over the entrance will produce a strong down draft which will effectively bar flies. This same breeze will be equally effective in cooling the passerby and inviting him into the cooler store interior—or at least causing him to pause and look in your windows as he cools off.

Fans blowing across large mirrors are more effective than soap or netting in keeping off flies and are far more attractive to look at.

In hotels and restaurants the value of the fan is obvious. In all places where customers call fans improve the buying conditions by making the buyer comfortable. In short there is little use in going to great pains and expense to make the store, hotel or restaurant attractive to the eye if it is not attractive otherwise—to the body.

3. Offices.—Coolness in an office is considered essential to good work, and yet you will still find some offices where fans are not used to the extent that they might be. Mental effort is dependent on bodily comfort. Mistakes multiply, work slows down and brain keenness diminishes when the "dog days" arrive—unless the humid heat is driven out of the window by electric fans. Often, too, office space which would otherwise be wasted because of lack of ventilation is made useful by the addition of a fan. Dark, stuffy inside offices are made comfortable by electric light and fans.

4. Institutions of All Kinds.—If coolness prevents sickness, it just as surely relieves suffering and promotes recuperation. Not only are fans desirable in an institution for comfort's sake, but they are even more necessary for sanitary reasons. Fans are a necessity to ventilate sick rooms and make the life of the old and infirm more bearable.

Utility Rates for Service Should Be Made Clear to Customers

AS THE business of distributing electricity for power has grown and the field for its application has widened the difficulty of charging for this service so as to treat with justice a great variety of industries and to encourage the extension of its use into still wider fields has led to a considerable complication in the problem of rate making. E. L. Wilder of the Rochester (N. Y.) Gas & Electric Corporation, in discussing methods of expressing rates before the recent commercial meeting of the Empire State Gas & Electric Association, pointed out that minimum charges, service charges, delayed-payment excesses and prompt-payment discounts are not readily understood by customers.

"The fundamental trouble with our rates," said Mr. Wilder, "especially the more complicated ones, is that they are not understood. It is a well-established psychological principle that persons are suspicious of anything they don't understand. We are all built that way, and we must not expect that our consumers will accept the bills which we hand them month by month if we make no effort to explain what they are being charged for and why. Why does your grocer or meat dealer set his scales right out on the counter where you can check his weights, and what would you think of him if he kept them back of the counter and out of sight where you could not do so? The question is, then, how shall we make these rates understandable? I am going to assume that these more complicated forms of rates are necessary for the handling of industrial business. The main difficulty is that the terms we use are not understood, and in order that we may have something definite to talk about I will assume that we have to deal with a rather complicated three-charge schedule in which the kilowatt-hour charge involves the quantity 'hours' use of maximum demand,' and I propose that we insert in our rate book or print for distribution to our power consumers the following brief discussion of the underlying philosophy of rates and explanation of terms used:

" 'Our rates for power are based upon the theory that each consumer should pay in proportion to the cost of the service rendered. The surest and simplest way of accomplishing this seems to be to divide the charge into three distinct parts so that the total bill is the sum of these three. While this method of charging is not so

easily understood as the simpler forms of rate schedules, still the experience of our own company and of many other companies throughout the country is that the advantages both to the company and to the consumer far outweigh the disadvantages.' "

Mr. Wilbur then followed with a detailed explanation of the principles involved and the reasons for minimum, consumer, demand and kilowatt-hour charges. When these are clearly understood by customers he thought much of the dissatisfaction with rates will be eliminated.

Good Citizenship and the Public Utilities

BACKING up the national campaign of good-will publicity, the Central Arizona Light & Power Company of Phoenix, Ariz., has run a series of advertisements in the local newspapers which was very productive of beneficial results. The advertisements were so well received that H. L. Aller, vice-president and general manager of the company, has had them set up in a booklet entitled "The Good Citizen and the Public Utility" and distributed to all of the company's customers. To explain the relation of utility service to the welfare of the community the introduction of the booklet says:

The Good Citizen is one who is always alert to exert his influence constructively for the good of the community in which he lives and to make life fuller for his neighbors and himself. Ignorance breeds destruction, whereas knowledge is a prerequisite of any constructive activity.

It is with the intention of bringing to every citizen of Phoenix intimate knowledge of the utilities in this city—what they have accomplished and are trying to accomplish in the upbuilding of the city, and the problems confronting them today—that this series of statements appears.

The good citizen realizes that, although his own vocation requires no knowledge of the gas and electric industries, nevertheless since this is a subject touching the life of the whole community, he must seek that knowledge which will enable him to exert his influence in the most constructive manner.

When a whole people are so dependent upon a commodity and a service, the character of that service is a vital force in the upbuilding of the community. Industries cannot become established where gas and electric services are not of the best. People will not come to a city to live where street lighting is poor, where electric and gas services are not available.

Since this service is so essential, it is right that these industries be regulated by the state to insure that the public shall have good service, that facilities be added to meet the growing demands of the city, that the charges for service be reasonable and just.

The duties and problems of regulatory bodies are discussed as follows:

Public utility regulation a few years ago was synonymous with rate reduction. The public service companies were frequently earning more than a reasonable return on their investments and were pared down in their earnings by the commissions until they earned only the minimum allowable return on the value of their properties. This made the regulating commissions very popular.

Today a different condition exists. During the past five years the costs of operation have continually advanced. Rates for gas and electricity have had to be advanced a sufficient amount to enable the companies to exist. The regulating commissions have fought against rate increases, granting partial relief here and there, but very seldom granting the full relief necessary for the public utilities. The public has not been fully informed of the facts so that the commissions have been condemned by the public for increasing rates and also by the public service companies for not increasing rates enough to compensate for advances in costs of operation.

No community can prosper and grow when poor service is rendered by the public utility companies. For community growth and prosperity these companies must be maintained in a healthy condition, able to keep their properties well maintained, able to pay for a good and efficient staff of employees and able to pay a good return to the investor who purchases their securities. With a dilapidated property, a poorly paid, inefficient corps of employees, and no new money flowing into the property from the sale of its securities to keep up with community growth, a public utility cannot give service. The good citizen will insist that the corporation commission shall regulate public utilities in a way which will give a square deal to the companies as well as a square deal to the public.

The public service company under regulation must secure the money necessary for its additions to plant, distribution system, meters, transformers and all similar property from the sale of its securities, namely, its stocks and bonds. The gas and electric utilities in Phoenix invested more than $800,000 in new property during the past two years. The construction budget for the next two years totals approximately $1,500,000. The extent to which these added facilities can be furnished to Phoenix depends upon the salability of the securities.

When regulating commissions do not permit the public utilities to charge rates for gas and electricity which will permit the companies to pay interest rates that will attract capital, the companies cannot build additions to plant and cannot adequately serve the public.

In conclusion the pamphlet says:

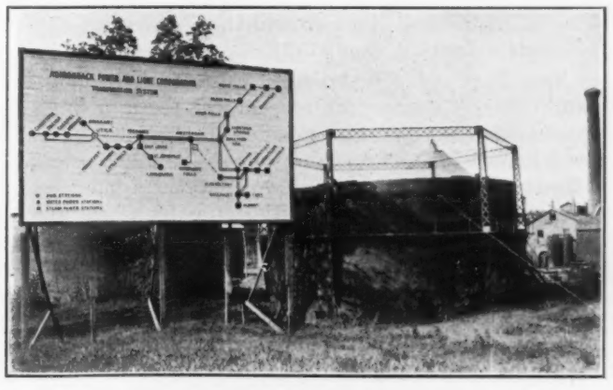
The good citizen has seen from the foregoing statements that a public utility's well being is essential to the public welfare. He realizes that without the support of the people —without his individual moral support—this essential industry cannot properly function.

It is the careless word spoken by the man in the street, the destructive criticism that unthinkingly slips out "to make conversation" at the tea table or elsewhere, that injures not only the public service companies but also the city as a whole.

When a public utility is exerting its every effort to build up its community, giving good service, operating efficiently under rates much lower than those current in the country as a whole, the good citizen will endeavor to assist constructively in meeting the difficulties that confront that industry from time to time.

One Way to Advertise Service

A VERY striking display board has been mounted by the Adirondack Power & Light Corporation at various points along the automobile routes in its territory, showing the layout of its transmission system. Locations of substations, water-power and steam-power stations are shown. Sites for these signs have been carefully chosen so that they will make the greatest impression upon automobilists.



DISPLAY BOARD PICTURING TRANSMISSION SYSTEM

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

The Propelling Motors of the U. S. S. Tennessee.—H. L. BARNHOLDT.—It is said that the wound-rotor type of induction motor was selected owing to the fact that with the squirrel-cage winding the heat developed in the rotor during reversal was so great that it could not be dissipated. Moreover, the power factor was higher with the wound-rotor motor. Speed control was obtained partly by changing the number of poles in the stator windings and partly by controlling the speed and frequency of the turbine generator. There are four main motors, each driving one propeller and rated at 7,000 hp. at 170 r.p.m. Design and constructional problems involved in the motors are also discussed.—*Electric Journal*, June, 1921.

Generation, Transmission and Distribution

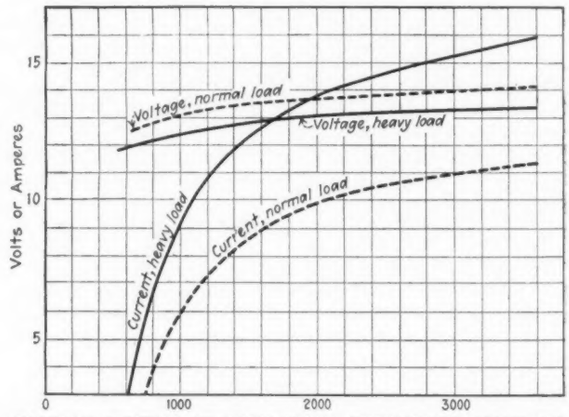
High-Tension Transmission Projects for the Electrification of France.—C. DUVAL and C. LAVANCHY.—The insufficient coal supply of France demands a more thorough utilization of all existing water powers. To make this effective and efficient a close study has to be made of the amount of power needed in the different consuming centers, the location of these and the possibility of transmitting the energy needed to them. The authors have studied these varied problems and show where it would be economical to locate power stations. One of these plants and lines, chosen as an actual example, is the line from Bellegarde to Paris, and it is shown that by adopting a three-phase system at 150,000 volts and 50 cycles about 25,000 kva. may be transmitted over a distance of 450 km. by one line at an over-all line efficiency of about 84 per cent, including transformer and synchronous-motor losses.—*Revue Générale de l'Electricité*, May 21, 1921.

Transmission Ring of Duquesne Light Company.—E. C. STONE.—A discussion of the method of power distribution adopted by this company, consisting of a closed ring of 66,000-volt lines around the Pittsburgh district. —*Electric Journal*, May, 1921.

New Type of Synchronous Vibration Rectifier.—L. SCHÜLER.—A number of mechanical rectifiers using a synchronously vibrating, magnet-operated contact have been known for many years, though little has been published about their theory. Two conditions must be fulfilled to obtain perfect rectification—the vibrator must operate absolutely in synchronism with the line frequency, and contact must be made and opened always at exactly the right time. The author has gone into the theory of these rectifiers and has succeeded in designing a new type. Its swinging armature is controlled by two strong springs. The weight of the swinging system, the pull of the springs and the amount of the artificially introduced mechanical damping are so exactly determined and adjusted that the contact opens virtually at the zero instant, obviating the need for a condenser. The connection and the principle of the rectifier are, however, such that only one-half of the alternating current is rectified, that is, the armature must swing but once during each period. This is achieved by superimposing a direct voltage over the alternating voltage. This in turn means that the new rectifier can be used only for charging storage batteries.—*Elektrotechnische Zeitschrift*, May 12, 1921.

Lamps and Lighting

The Latest Bleriot "Phi" Starting and Lighting Equipment.—The generator and starting motor of this equipment are separate units, the "single-unit" system having, according to the author, been found unsuitable for large engines. The generator, called a "bi-compound" machine, contains one shunt field and one series field, the series winding exerting a demagnetizing action. To improve the control a voltage regular of the vibrating type introduces a resistance into the shunt winding when the voltage of the machine rises above a certain value. There is also a tap on the series field winding from which current is led off in case of extra-



VOLTAGE CONTROL OF HIGH-CLASS AUTOMOBILE GENERATOR

heavy demands for it, thus decreasing the demagnetizing action of the series field. The starter is a series-wound motor. This equipment is said to be particularly suited to high-priced cars.—London *Electrician*, May 27, 1921.

Traction

Electrification at 3,000 Volts on Paulista.—Details of locomotives, substation and power distribution system for one of Brazil's best railroads are given by engineers of American manufacturers who supplied equipment. Greatly increasing activities in the electrification in Brazil are indicated.—*Electric Railway Journal*, June 11, 1921.

Scientific Fundamentals in the Design of Rolling Stock.—DR. E. SEEFEHLNER.—The low ebb of all the Austrian street-railway systems is regarded as of only temporary character, and they are expected to revive and begin reconstruction in the near future. The author therefore takes occasion to review theoretically a few

important details of street-railway construction to aid car design. Among these details are studies of wear of wheels and rails and of the best construction of brakes, car bodies and gears.—*Elektrotechnische und Maschinenbau*, May 29, 1921.

General Electrification of Jugoslavia.—M. DIMITRIJEVIC.—The favorable geographical location of Jugoslavia, with its abundance of water power and vast coal fields, justifies an extensive general electrification of the new republic. The article is an abstract of an official electrification program to be presented shortly before the Jugoslavian parliament.—*Elektrotechnische Zeitschrift*, May 19, 1921.

Electrochemistry and Batteries

Ozone.—ALBERT CLARKE.—The electrical production of ozone and some of its uses, such as for water purification and sterilization, are discussed.—*Beama* (British Electrical and Allied Manufacturers' Association), May, 1921. Systems are grouped according to whether a dielectric is inserted between electrodes.

Installations, Systems and Appliances

Present Limits of Electrical Machinery—III and IV —Switching Apparatus and Lines.—W. REICHEL.—The increasing capacities of electrical central stations necessitated the development of electric switches capable of safely rupturing huge amounts of energy. The hand operation of such switchgear was no longer possible, and motor or magnet power was introduced instead. The most severe endurance test is imposed upon a large-capacity switch when it is closed upon a still existing short circuit. The largest direct-current switches are probably used in the electrolytic industries, comprising sizes up to 250-volt and 20,000-amp. A 17,000-amp. switch, operated by a magnet with turning armature, is shown. For alternating-current switches such high currents are never encountered, but values may reach 10,000 amp. A three-pole, 6,000-amp., 500-volt motor-operated air-break switch is shown. All alternating-current switches for high voltage must have oil-immersed contacts to quench the arc properly. The problem with oil switches of large rupturing capacity is the proper care of the gases generated in the oil during the break. For this reason all multipolar switches are subdivided into individual switches for each phase. No other way of safeguarding has been found than to build the oil containers fully pressure-proof, withstanding as high a pressure as 15 atmospheres. Photographs and sketches are given of several 6,000-volt to 150,000-volt, three-phase switches. The article closes with a short description of high-voltage lines using disk-type insulators. Sketches are given for single and double strings up to 100 kv., and vector diagrams for compensated and uncompensated lines up to 260 kv. Special attention is given to the proper transposition of such high-voltage lines to prevent inductive disturbances.—*Elektrotechnische Zeitschrift*, May 14, 1921.

Novel Methods for Use of a Grounding Choke Coil.—PROF. REIHOFFER.—The well-known, and in Europe much used, Petersen grounding choke coil can be employed on Y-connected generators or transformers, being connected between the Y point and ground. The author also shows several different ways to use such a protection coil on delta systems. The usefulness of these methods is proved mathematically.—*Elektrotechnische und Maschinenbau*, May 22, 1921.

Units, Measurements and Instruments

Influence of an Electric Current on the Photo-Electric Effect. — ALLEN G. SHENSTONE. — Experiments were made to show whether there was any relation between the Hall effect in bismuth and the photo-electric effect. It was found that the total photo-electric current was so much influenced by the current passing through the bismuth that the variation of this apparently new effect was investigated.—*Philosophical Magazine*, June, 1921.

Oscillographic Measurements of the Instantaneous Values of Current and Voltage in the Battery Circuit of Automobiles.—GEORGE W. VINAL and C. L. SNYDER. —An investigation to study the demands upon starting and lighting batteries in the operation of various types of automobiles. Oscillographic records of current and voltage were obtained. In addition to the data relative to the battery requirements, the interpretation of the records has indicated the possibility of using this method for the study of lubrication and engine problems relating to speed, friction, ignition, compression and distributer action.—*Technologic Paper No. 186, U. S. Bureau of Standards.*

Telegraphy, Telephony and Signals

Radio Developments for Airplane Use—Indirect Excitation Apparatus — II. — M. BERNARD.—This article gives a detailed description, diagrams and many illustrations of the different types of sending and receiving apparatus used on French airplanes and seaplanes during the war. All the more recent models were energized from high-frequency generators driven by small propellers. In their principle all types were identical, using a step-up transformer, two mica condensers, a variable inductance, a wave-length variometer and a paid-out-wire antenna. The proper resonance to a desired wave length was determined by readings on a hot-wire ammeter. An interesting detail was the spark gap, which was cooled and quenched by a specially collected and directed current of air taken in by a rubber funnel mounted on a wing and connected to the gap by a rubber hose.—*Radioelectricité*, May, 1921.

Some Improvements in the Poulsen Arc.—P. O. PEDERSEN.—A study showing the importance of getting the correct magnetic field in the operation of the Poulsen arc.—London *Electrician*, June 3 and 10, 1921.

Miscellaneous

Hydro-Electric Power Possibilities Along the Main-Danube Canal in Bavaria.—The possibilities of large water powers along this canal have been investigated, and the results of this preliminary work have been published in a book by J. Hallinger, Munich. The canal in its present form would yield about 100,000 hp., but with some additions and connections with other watersheds up to 1,000,000 hp. may be obtained. All data are based upon careful hydrographic observations and rough cost estimates. Sketches of the proposed sites are included in the paper.—*Elektrotechnische Zeitschrift*, May 19, 1921.

Scottish Water-Power Schemes.—It is proposed to utilize the yield of a catchment area in the vicinity of Loch Laggan and Loch Treig in which the annual rainfall is probably fully 70 in. (178 cm.). The average available head at the turbines will be nearly 700 ft. (213 m.), giving an average development of 72,000 horsepower. The works will be constructed so that over 100,000 hp. can be developed when sufficient water is available.—London *Engineer*, May 20, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

State Development of Water Power Means Taxation

"STATE development of water powers presupposes bonding property for millions of dollars, taxation for weary ages to pay the bonds, operation by state employees without the incentive of competition or pride in one's work, and a population leisurely operating until the hour for presenting their pay checks," declared Charles P. Barnes, speaker of the Maine House of Representatives, in a recent address at Rockland, Me. After sketching the early development of water powers in the state, Mr. Barnes pointed out that a survey of its rivers from the thoroughly developed Presumpscott to the distant Aroostook, furnishing light and power for all of northeastern Maine, tends to demonstrate that development by private capital has gone hand in hand with demand. State development, he contended, would drive away the men of its population gifted with initiative, energy and courage who have built up the present systems of supply and profited on their investment. It is not the duty of the state, he intimated, to supply electricity to every homestead regardless of its remoteness from the trunk lines of commerce.

Progress in Standardization Is Reported by A. M. E. S. at New London

THE summer meeting of the Associated Manufacturers of Electrical Supplies was held at the Hotel Griswold, New London, Conn., on Monday, Tuesday, Wednesday and Thursday of last week. Far from normal as general business conditions are, the attendance at the various section meetings was the largest in the history of the association. Naturally much of the discussion centered on present conditions in the electrical industry. It was evident that many manufacturers are finding it difficult to conduct business profitably even though prices of materials have been considerably reduced. Some wire manufacturers find themselves in grave financial straits, while others are preparing to shut down for a month or so to get rid of accumulated stocks.

Efforts at standardization are going forward and will become effective within the year. The Radio Apparatus Section, which was formed in May, elected its committees and laid plans for a publicity campaign on radio matters to offset the erroneous information often printed by the daily press. The manufacturers of panelboards and switches held a very long session in an effort to arrive at certain standards acceptable to all. Particular attention was given to interpretations, usages and safety matters in connection with rulings of the underwriters. Meter entrance service standards were also proposed. Similar questions came up before the Knife Switch Section, the name of which was changed to Knife and Inclosed Switch Section. An arrangement has been effected among eleven manufacturers of attachment plugs and receptacles to turn out a standard plug and receptacle for lighting fixtures which will carry the name "Elexit." Models were on exhibition for wall and ceiling application, and it is expected that production will take place in the late fall or winter.

The Heating Appliance Section elected Walter Stearns chairman.

Los Angeles Wins Fight to Condemn Property of Southern Sierras

LOS ANGELES has acquired through a suit in the United States District Court in San Francisco the right to condemn the Owens River Gorge property of the Southern Sierras Power Company, the price which the city must pay being fixed at $525,000. The city claimed that this property was essential to its own plans of power development, while the company declared that the area was needed by it to supply future demands from Riverside, Redlands, San Bernardino and Imperial Valley towns. The city contended that the company had other sources of power in Leevining and Bishop Creeks.

Riparian water rights alone were considered, it being agreed that no value attached to the 320 acres of land itself. The rights were bought by the Southern Sierras Power Company shortly before the filing of the suit on Feb. 9, 1920, for $400,000. Engineers testifying for the company fixed the value at $722,000 and $900,000.

No damages were allowed for the Adams power plant erected by the company on the site in dispute, on the ground that this improvement was begun subsequently to the filing of the suit. The company may appeal.

Why Utility Rates Are Not Dropping

A NUMBER of reasons for maintaining utility rates at their present levels are given in a public statement just issued by J. P. Pulliam, president of the Wisconsin Electrical Association and Wisconsin Gas Association. The statement is in reply to questions coming from various parts of Wisconsin asking why prices of public utility services are not dropping with those of other commodities. It is prefaced by the declaration that public utilities are the only business whose operating sheets did not record payment of excess-profit taxes during the war.

"One reason that many people seem to forget is that utility rates did not advance comparably with commodity prices during the period when farmers', laborers', retailers', manufacturers' and property owners' profits soared sky high," said Mr. Pulliam. "Utilities' earnings were anchored to earth by regulation. They were not

permitted to earn profits of 100 per cent and more all those years, like other businesses were. Utilities obtained increases only within the last year or so, and those increases limited them to 6 and 8 per cent returns. If utility rates did not double, treble or quadruple, naturally it is impossible to contract them like other commodities. Utilities were and still are the cheapest commodities necessary to life on the market today.

"Another reason is that during this period when utility earnings were not permitted to soar their operating costs steadily increased. Drops in prices of commodities used by utilities have been more apparent than real. To get back to pre-war levels would mean that commodities used by utilities would also have to be based on pre-war prices. That would mean that coal screenings which now cannot be contracted for at less than $2.50 a ton at the mines would again have to go down to 80 cents a ton, where they were four years ago. Pre-war rates would also mean basic freight rates 60 per cent lower than they are today, and labor would also have to be on a pre-war basis.

"A further reason is that utilities are being bowed under a constantly accumulating tax load. In Wisconsin taxes on utilities have increased in the past ten years 238 per cent, and I am just informed that the tax commission has announced another increase of 11 per cent or more for 1921. In many instances increases in taxes alone are such as to offset all reductions in cost of coal, materials, supplies and operation. In some instances taxation is forcing rates higher.

"People did not show a great concern about such small items as utility rates when they were being kept down while all other prices went up, but now when they are being raised 2 and 3 cents for street-car rides and a small amount per month for gas and telephone services, to meet higher operating costs, people who generally will be reasonable when they stop to think are persistently refusing to do so.

"The utilities seek the co-operation of the public with the strong desire to give the people the best service possible, if for no other reason than a selfish one, for the more and better we please the public the more of our service the public will use. The interests of the public and of the utilities therefore are in accord, not in conflict."

International Commission Gets St. Lawrence Report

THE International Joint Commission received this week the report of Col. W. P. Wooten and W. A. Bowden, the engineers appointed respectively by the American and Canadian governments to make a survey of the possibilities of canalization of the St. Lawrence as a means of shipping and the relation thereto of hydro-electric power. They report that the work would cost $250,000,000 and would result in the development of 1,700,000 hp. at the ten locks planned. Plans are submitted for 25 and 30 ft. depth waterways 120 miles long.

Four methods are suggested: (1) Locks and navigation dams in the river, (2) locks and side canals, (3) a combination of the two previous, and (4) by means of locks and power dams. The report recommends a combination of the four, declaring that the power so developed would pay for the entire project in a few years.

The report now awaits the action of the International Joint Commission.

House Passes Radio Bills

THE House of Representatives has passed a bill authorizing the Secretary of the Navy to use all the radio stations of that department for the transmission of press messages and private commercial messages. The bill in the form passed by the House provides that the rates must not be less than those charged by privately owned radio stations. The authority is to cease when the privately operated stations are sufficient to handle the business offered. The bill now goes to the Senate for consideration.

The committee on military affairs of the House also has reported favorably the bill authorizing the Secretary of War, the Attorney-General and the Secretary of the Navy to adjust all meritorious claims against the United States arising from the use by the United States of patented inventions relating to radio communication. The bill as recommended by the committee appropriates $2,500,000 for the settlement of these claims.

Delegates to the 1921 Canadian Electrical Convention at Quebec

Energy Sales of Pacific Gas & Electric Increases 50 per Cent in Year

GROSS operating revenue of the Pacific Gas & Electric Company for 1920, according to the annual report of the directors, just issued, was $34,475,372, as compared with $25,938,372 in 1919, and net earnings from operation were $11,024,773, as compared with $9,689,245. In its four branches of service—gas, electric, water and steam—the company served 569,360 customers, a gain of 386,745 in thirteen years. Electric service customers increased from 54,772 to 266,132 in that period, and in 1920 30,413 electric customers were added, as against 18,328 in all three other branches. Sales of electric power last year reached nearly $11,000,000, an increase of 170½ per cent over 1915. Total sales of electrical energy in 1920 to all classes of customers were $21,571,321, or $7,096,437 more than in 1919.

Homer Electric Company Wins in Inductive Interference Dispute

REAFFIRMING its previous grant to the Homer Electric Light & Power Company of a certificate of convenience and necessity to establish a 13,000-volt service to rural customers along a country road, the Illinois Public Utility Commission on June 30 handed down its decision in the Homer inductive interference case. Specifically stating that the issues were whether one utility could bar another from the highways by reason of its prior occupancy and whether the creation of an additional parallel line would increase existing disturbances to such an extent that substantial interference with the commercial service of the telephone company would result, the commission holds that the needs of the property owners who have dedicated the roads for purposes of travel must receive first consideration. These owners cannot be deprived of a needed service through the application of the "prior rights" theory. On the second point the commission holds that to receive consideration interference must be of a character distinctly injurious to the commercial service given over the telephone circuits. In the case at issue the evidence was held to be conjectural and not to show that substantial interference would be the result of the new transmission line.

The Homer Electric Light & Power Company therefore received the right to proceed with the operation of its newly constructed circuit. The telephone companies are instructed to submit a plan of co-ordinated transpositions that will be needed if interference develops. The power company will be required to eliminate the single-phase taps from its three-phase lines by making them three-phase. The division of the expense of a co-ordinated system of transpositions will be considered by the taking of further evidence, in case it becomes necessary, though the commission expressed the opinion that in cases involving new construction each company should bear its own expense.

The case involved the right of the power company to construct in addition to the 7½ miles of its present circuit approximately 5 miles of 13,000-volt circuit along a country road. This construction had once been forbidden because the consumer—a coal mine—could be reached by another route. In September, 1920 when farmers along the route petitioned for service, permission to construct the line was granted, and the present decision is the result of a rehearing on the petition of the telephone companies interested. Jurisdiction for further consideration of the case is expressely retained by the commission.

Utilities Oppose Depreciation Fund Ruling of Oklahoma Commission

REPRESENTATIVES of the gas, natural-gas, telephone and electric light and power companies of the State of Oklahoma were unanimous on June 21 in opposing the order of the state Public Utility Commission relative to depreciation funds. This order which was to have become operative July 1, required the creation and maintenance of a separate depreciation reserve fund. No dividends in excess of 6 per cent were to be permitted until the full amount of allowed depreciation had been paid into the fund. The fund could be used only (a) for depreciation, (b) for investment in high-grade securities at not less than 4 per cent, or (c) the company might borrow for not more than three years to the extent of not more than 60 per cent of the cost of extensions, additions, etc. The rule is in many respects almost identical with the Crown Point Telephone Company order of the Indiana commission of Dec. 28, 1918. This order was suspended in January, 1920.

The utilities had twenty days in which to submit briefs. Fred Herbert, director of the service department of the N. E. L. A., was present at the hearing and has submitted a brief. The utilities are contending for a reserve sufficient to take care of recurring replacements as against a definite fund separately maintained. Under the proposed ruling, the utilities contend, it would be almost impossible to obtain money for construction purposes. Besides, they see no reason why the public should be burdened with high money costs when the funds are available in a depreciation reserve.

Municipal Board in Centralia, Wash., Backs Utility Against Commission

AN UNUSUAL, if not unprecedented, utility situation is presented at Centralia, Wash., where the municipal Department of Public Works is backing the North Coast Power Company, the former holder of the city lighting contract, against the Sherman County Light & Power Company, an Oregon company authorized to do business in Washington and to which, on the expiration of the North Coast company's contract, the city transferred its lighting business.

The arrangement with the Sherman County company, whose proposed Centralia rates are uniformly lower than those of its competitor, was made after an increase in the wholesale rates of the North Coast company. The Department of Public Works, however, maintains that the prior occupant of the field did not realize undue profit, pointing out that it is essential to continuous and adequate service that rates be sufficient, and dwelling on the statutory requirement that the department shall make such rates as will produce adequate net income for continuous and prosperous business and prevent unjust discrimination between individuals and communities. The department holds that the rates of the newly established company are too low to insure good service with proper repairs and extensions.

Chicago Appliance Sale Ordinance Laid Over

AT A RECENT meeting of the gas, oil and electricity committee of the Chicago City Council it was decided to lay over until fall the proposed ordinance to license the sale in Chicago of electrical appliances. The proposed ordinance has been the target of much opposition, and at the last meeting of the committee the original ordinance was considerably amended in order to reduce this opposition. Consideration of various amendments was so prolonged that it became impossible to get the bill before the Council previous to the summer vacation.

Commercial and Merchandising Problems Before New York Association

COMMERCIAL department organization and merchandising methods were the chief topic of discussion at the meeting of the Commercial Section of the Empire State Gas & Electrical Association held in Cooperstown, N. Y., June 24. Advocating the solicitation of new lighting customers because this business nets the utility a higher return considering the investment involved than any other class, W. J. Reagan of Utica pointed out that because of the constant development of new appliances the so-called saturation point in sales can never be reached. He further stated that the central-station company should maintain a repair service for socket appliances, as in many communities it is estimated that only 25 per cent of the appliances that have been sold are in service. In connection with the securing of new house-wiring contracts Mr. Reagan described a co-operative plan which had been worked out by the central-station company, the contractor-dealers and one of the principal banks whereby the company's salesmen secured this business, the contractor-dealers did the actual work and the bank carried the deferred payments of the customer. This plan has been found highly satisfactory to all the parties concerned.

In a paper on the "Method of Expressing Differential Rates for Commercial and Industrial Consumers," E. L. Wilder of Rochester presented an interesting analysis of the various classes of rates and the different factors which enter into rate making.

That many of the complaints received by utilities from their customers are due to the indifferent attitude of some company employee was brought out by John H. Ghegan in a paper on "Meeting the Public in the Commercial Office."

Good service and systematic maintenance of appliances are primary essentials to successful merchandising, asserted S. Smith of the New York State Gas & Electric Corporation in discussing the sale of appliances to commercial and industrial consumers.

Under existing financial conditions extensions of service must be most carefully considered, according to H. A. Doering of the Westchester Lighting Company, who pointed out that new extensions should be made only on a profitable basis in order further to attract new capital.

In presenting the preliminary report of the committee on rural lines, B. H. Shepard brought out the fact that even though the farmers pay the entire first cost of a rural line, the fixed charges, such as maintenance, taxes, depreciation and ultimate renewal, must be paid by the electric light and power company. As a means of decreasing the cost of construction and reducing the service charges to consumers on these lines Mr. Shepard suggested the organization of highway lighting systems. As a further means of reducing cost of construction Mr. Shepard thought that it would be possible, on single-phase lines, to use 250-ft. spans instead of 125-ft. spans, the total cost of which per mile of line would be $1,088.13 and $1,510.85 respectively, or a saving of $422.72 per mile on the longer spans.

N. E. L. A. Executive Committees Lay Groundwork for New Year

MEETINGS of the executive committee of the N. E. L. A. and of the executive committees of the Public Relations and the Accounting Sections were held last week at headquarters in New York. The Technical Section executive committee meeting was postponed, probably until late in July. The Commercial Section's executive committee is scheduled to meet later this month at Association Island.

The national executive committee went over details incidental to laying out a program for the year. Pending the organization of the Eastern Geographic Division of New York, New Jersey and Pennsylvania, it was resolved that the Pennsylvania Electric Association be recognized as the Eastern Geographic Section. The next meeting of this committee is scheduled for Sept. 1 in New York.

At the meeting of the executive committee of the Public Relations Section the question of interesting women employers in public relations was taken up, with the thought that perhaps they could reach the women of any community better than could the men. A committee on public speaking is to be formed, also one in each geographic division and then one in each state. The committees of last year are to be continued.

Final action was taken on the association's good-will film, "Back of the Button," and distribution of this film will begin about Aug. 1. The first public showing of this film will take place at the New York Hippodrome, where it will start a two weeks' run next week.

In the Accounting Section steps were taken whereby every Class A member will be advised of the status of the commission accounting system in his state in relation to the uniform classification of the association. Every effort will be made this year, it is said, to make this classification national as far as possible.

Contractors to Emphasize Spirit of Optimism at Convention

EMPHASIS will be placed on the spirit of optimism at the annual convention of the National Association of Electrical Contractors and Dealers to be held week after next in Buffalo. The convention, which will be held at the Lafayette Hotel, July 18 to 23, will be built around the theme of looking forward to better business, according to W. H. Morton, general secretary of the association.

From present indications the convention will be as large as, if not larger than, previous ones. Some of the state associations in the East are planning to hold their annual convention in conjunction with the national convention. The program was printed on page 1010 of the ELECTRICAL WORLD for April 30.

Reclassification of North American Stock Proposed as Aid to Financing

IN ORDER to raise new capital and make the company's stock attractive to investors, a plan for reclassification and readjustment of the capital stock of the North American Company has been proposed to stockholders. At present, there is $29,793,300 outstanding of $30,000,000 authorized capital stock, all of one class. Under the proposed plan two classes of stock will be provided, 6 per cent cumulative preferred and common, each authorized to the amount of $30,000,000 The preferred is to be redeemable at 105. It is not proposed to increase the outstanding stock at present, but to issue for each $100 of stock outstanding $50 of new preferred stock and $50 of the new common.

In submitting the plan the committee says:

"The subsidiaries of your company serve rapidly growing districts comprising some of the most important industrial centers in the country. The demand for increased facilities has grown continuously and rapidly. With this demand have come large requirements for new capital. Continued exclusive use by subsidiaries of bonds and notes to finance the cost of such added facilities tends in time to produce a financial set-up topheavy in debt and generally to impair the credit of your company and its subsidiaries.

"The rapid growth of the properties has required a larger amount of capital than the subsidiaries could provide, and it has been necessary to make up the balance from surplus earnings, the quoted market discount on the stock of your company as now organized making it impossible to meet these capital requirements from the sale of additional amounts of such stock. It thus becomes imperative that a readjustment of capitalization be effected which will make it practicable to raise new capital and permit the distribution of a larger proportion of these earnings to stockholders."

The total net earnings of the company available for dividends, depreciation and surplus during the past twelve years have amounted to $41,607,582.82, or $139.65 per share. Of this $24,600,574.07, or $82.57 per share, was reinvested in the properties, while $17,007,008.75, or $57.08 per share, was distributed to stockholders as dividends.

Coosa River Development Again Going Forward

WORK has been begun by the Alabama Power Company on the Duncan's Riffle project on the Coosa River, a permit for which was granted by the Federal Power Commission June 27. The dam, to be known as the "Mitchell dam," will be completed in about two years.

It is interesting that this project, which is named after the late James Mitchell, was authorized in 1912 by both houses of Congress but was vetoed by the president. This was at the beginning of the controversy over water-power legislation. The existing plant at "Lock 12" was authorized in 1907 and placed in operation in 1913. It is now proposed to follow along the plan originally laid down by Mr. Mitchell.

The dam will be 1,200 ft. long and develop a head of 68 ft. The initial installation will be two single-runner, vertical, 24,000-hp., direct-connected units. with provision for three more units.

It is planned to introduce two noteworthy departures from previous designs of similar plants. One of these is the location of the units, which will be on the upstream side of the dam, each in a separate inclosure and on its own concrete foundation and with electrical connection through a gallery connecting the several units. The other departure is in the design of the draft tubes. An improvement is introduced here which will reduce the loss of head during a period of high water by causing the draft tubes to discharge upward at the toe of the dam.

Pacific Coast Division, N. E. L. A. Banquet

MANY notables, some from the Atlantic Coast, attended and took part in the annual convention of the Pacific Coast Division of the National Electric Light Association, held this year in June at Del Monte, Cal., to which representatives of California industries were invited to hear of the dependence of the Pacific Coast on electrical progress.

Arlington Radio Plant Little Affected by Lightning Bolt.—Last week during a severe electrical storm the navy radio station at Arlington, Va., was struck by lightning and had temporarily to suspend operation. Men were at once set to work to put the plant back into operation, and the interruption was of short duration. No one was injured by the bolt.

Alabama Power Company Completes Interstate Transmission Line.—The interconnecting line between Gadsden, Ala., and Lindale, Ga., has been completed by the Alabama Power Company and is now in operation. It connects the power systems of the two states, permitting the importation of energy by either from the other in case of low water or accident to the service.

Milwaukee to Have Electrical Show.—An electrical show will be put on in the auditorium at Milwaukee, Oct. 24 to 30, 1921, by the Milwaukee District of the Wisconsin State Association of Electrical Contractors and Dealers. A bungalow, 30 ft. x 60 ft., to be erected at a cost of between $15,000 and $20,000, will be fitted up as an electrical home. Every possible use of electricity in the home will be represented.

Another Great Battleship to Be Electrically Propelled.—The Maryland, the latest and most powerful of the United States Navy's superdreadnoughts and the first to mount 16-in. guns, is, like her sister ship, the California, electrically propelled and electrically equipped throughout. Her electric propulsion equipment was manufactured by the General Electric Company. The Maryland is 624 ft. long, with a beam of 97 ft., and displaces 32,000 tons. She carries eight 16-in. guns in four turrets, giving her the longest range of all the vessels in the navy. She is expected to go into service early in the fall.

Combating Insects with an Appetite for Insulation.—The installation of electrical apparatus in the tropics where bugs and insects abound has given rise to a number of problems not met with in the temperate zone, says a house-organ article issued by the United States Rubber Company. In some tropical countries ants have shown an amazing appetite for the insulating covers of electric wires, while in others electrical systems have been sadly disarranged by spiders, which seem to regard the wires as gymnasium apparatus put up for their special amusement. In Southern India white ants have discovered that the paraffine finish of annunciator wire is very good eating and that the cotton braid underneath is a genuine delicacy. To circumvent the insects wire sent to this section is now covered with a black weatherproofing compound for which bugs have no appetite. There is also a type of borer that will bore its way through any thickness of lead covering used on armored cables. This presents a serious problem, as moisture works its way through into the conductor, causing short circuits.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Wireless Men Entertained at Top of Eiffel Tower.—The fifty delegates attending the international wireless conference at Paris were recently entertained, with their wives, at the highest level in the Eiffel Tower—a point beyond where the public is permitted to ascend. Their host was Alexandre Gustave Eiffel, the builder of the tower, who is eighty-nine years old. He met his guests at the bottom of the tower and escorted them by elevator to the top. Major-General Squier, chief of the Signal Corps of the United States Army, with others, thanked Mr. Eiffel for his "surprise party."

The English Electricity Supply Bill.—No progress had been made at last report on the bill introduced into the British Parliament to amend the electricity supply bill. This amendment was looked upon as highly desirable in order to promote the co-operative measures of the existing act and especially to make their financing more easy. However, the London *Electrician* is of the opinion that there need not be any break in the activities of the electricity commissioners. They can, it says, continue the work of defining and delimiting electricity areas, the investigation of existing sources of supply and the collection of data. Their powers are sufficiently wide to enable them to bring great pressure to bear upon both municipal and company "undertakers" in order to co-ordinate and standardize methods of supply and distribution, and they can, apparently, set up joint boards or committees of local authorities as temporary substitutes for the joint electricity authorities authorized in the act.

Exciting Time in Pine Bluffs (Wyo.) Generating Plant.—There seems room for improvement in customer relations at Pine Bluffs, Wyo., to judge from the following account of trouble sent to the ELECTRICAL WORLD by the superintendent of the local generating plant: "On June 18 we had a real attempt to wreck a generator in the Pine Bluffs plant. On this day we had disconnected thirty-eight customers who had been failing to pay their bills. As the town night watch had recently left, the night engineer had instructions to make short trips, about two blocks from the plant, to watch the town and stores. About half-past one he locked the doors and when about two blocks away a heavy load came on the engine. Running back to the plant, he found the room full of insulation smoke and started up a 100-hp., 72-kva. unit and transferred the load to it. Getting to the plant myself by this time, we were unable to find anything wrong or burned about the small 40-kva. generator and put the load back on it. Further search showed a window screen torn off, and, noticing some solder on the foundation of the 72-kva. unit, we saw that the generator had been switched in on the line when not running, and the rotating field generated had developed enough heat in the outer 1½ in. of the field poles and coils to char the insulation. As there are only about three or four volts across the coils and they were built out away from the iron, leaving an air space, we are still using the machine, which is a Westinghouse connected to a Fairbanks-Morse engine. About a month ago some one fired a shotgun through the door at the 40-kva. generator but did no damage to it. The shot glanced off and went through some new Cutter street hoods, spoiling the enamel. This generator is a 40-kva. connected to a 50-hp. Fairbanks-Morse engine. The little engine stalled when the switch was thrown in. Incidentally," adds our correspondent, "the night engineer does not have to do any more watching outside the plant."

Associations and Societies

West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers.—The annual convention of this association will be held in Huntington, W. Va., on Sept. 20 to Sept. 23.

Empire State Gas and Electric Association.—The annual convention of this association has been set for Oct. 6 and 7 next, when public relations will be discussed from various standpoints.

Indiana Electric Light Association.—The annual meeting of the Indiana Electric Light Association will be held at French Lick Springs in September, according to an announcement by the secretary, Thomas Donohue of Lafayette.

Coming Meetings of Electrical and Other Technical Societies

Ohio Electric Light Association — Cedar Point, Ohio, July 12-15. (For program see issue of July 2, page 37.)

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

American Physical Society, Pacific Coast Section—Berkeley, Cal., Aug. 4 and 5.

Michigan Electric Light Association — Ottawa Beach, Mich., Aug. 24-25.

N. E. L. A., New England Division—New London, Conn., Sept. 6-9.

N. E. L. A., Great Lakes Division—French Lick Springs, Ind., Sept. 14-16.

Association of Iron and Steel Electrical Engineers—Chicago, Sept. 19-24.

Illuminating Engineering Society—Rochester, N. Y., Sept. 26-30.

American Electrochemical Society — Lake Placid Club, N. Y., Sept. 29-Oct. 1.

American Electric Railway Association — Atlantic City, N. J., Oct. 3-7.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Surcharge on Energy Purchased by Municipality.—The city of Redlands having complained to the California Railroad Commission against having to pay a surcharge on energy purchased from the California Railroad Commission, the commission overruled the protest, declaring that a municipality which is not primarily engaged in the operation of a municipal electric utility but uses the major portion of the energy it purchases for operating pumps is not entitled to exemption from the surcharge.

Low Rates with Inadequate Service Is a Short-sighted Policy.—"This commission," the Arizona Corporation Commission declared in a recent rate decision, "is in a position where it can by a short-sighted policy gain certain popular approval by regulating the public utilities of the state down to a position of insolvency. The temporary public benefit which would result from such a policy would be many times offset by the inferior and inadequate service that is always the result of such conditions, and the restriction to extension of service to developing territories is manifestly prejudicial to public interest."

Oklahoma Commission Reduces Rates.—The Oklahoma Corporation Commission has issued a temporary order reducing the electric rates of the Oklahoma Gas & Electric Company in the cities of Oklahoma City, Norman and Moore to correspond to decreases in the fuel costs of the company. "It has been the policy of this commission," the decision says, "during war times and during the times of constantly increasing fuel costs properly to adjust the rates for utilities engaged in the production and distribution of electricity so as to keep fuel costs and the rate as near as possible on the same level. It now becomes its duty when fuel costs are shown to have decreased and the cost of production per kilowatt-hour of electrical energy has substantially decreased to be equally prompt in readjusting the rates in conformity to such decrease."

Taxation of Utilities in California.—In handing down the decision of the California Railroad Commission still further reducing the surcharge that had been allowed the Pacific Gas & Electric Company and the Great Western Power Company (see ELECTRICAL WORLD, June 4, page 1329), Commissioner Rowell made these observations on utility taxation: "The present method of taxation applicable to corporations such as the Pacific Gas & Electric Company is to a certain extent a hybrid between an ad valorem and an income tax. In legal theory it is a property tax, but the measure of the tax is computed on a gross income basis. The taxes which become a lien on the company's property in March, 1921, are computed at 7½ per cent of that amount to the state during the succeeding fiscal year. Where a company's business continually increases, as applicant's has done, computation will show that the amount due in July of each year and which becomes a lien upon the property in March of that year is less than the amount which would be estimated on an accrual basis for the same period, so that a fund will accumulate in any such reserve."

Test of Confiscatory Rates in a Combined Utility.—A test of confiscatory rates in a combined electric and steam-heating utility is whether the particular service sustains itself, the Montana Public Service Commission observed in denying for the time being an increase in the rates charged for electricity at Glendive by the Eastern Montana Light & Power Company—not whether it can subsist by operating at the expense of some other service or from the private purse of its owner. Rates should not be higher in either of two combined services rendered by a public utility than the value of that service to the public standing alone.

Indorsement of Service Charge.—The Public Service Commission for the Second District of New York, which has been superseded by a new regulating body, often declared its belief in the propriety, fairness, reasonableness and legality of a service charge. Declaring in one of its later decisions that "It is but just that each customer should only pay for what he receives, and the imposition of a service charge on all alike to cover those items which apply to all alike seems best calculated to attain that end," it went on to cite thirteen state commissions as having approved this principle, asserting that there seemed to be no contrary decision.

Past Profits Cannot Effect Valuation.—In valuing the property of a telephone company the Nebraska State Railway Commission emphasized the point that the past profits of a utility, even where these have been excessive, have no bearing upon a valuation proceeding, in which all the physical property used and useful in the business of a utility must be considered, notwithstanding that some of it may have been built out of surpluses over and above a moderate rate of return. "Testing the effect of rates in the past," the commission observed, "is a judicial process; making rates for the future is legislative. The two processes ordinarily merge in a rate case. In a valuation case, however, the commission has no power to take part of the property of a utility and restore it to the public or deny its ownership to the utility. In a rate case the commission can take cognizance of the effect of past rates and whether they have been unusually remunerative."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Court Erred in Seeking to Compel Electric Service Where Ability and Willingness to Pay Were Denied.—Ruling once more against the Southern Power Company in its renewed attempt to have the suit brought against it by the North Carolina Public Service Company to compel electric service transferred to the federal courts (see ELECTRICAL WORLD, Dec. 25, 1920, page 1282), the Supreme Court of North Carolina none the less set aside the finding of the lower court giving judgment for the plaintiff in mandamus proceedings. The Supreme Court declared that inasmuch as the allegation of the plaintiff that it was able and willing to pay a reasonable rate for electrical energy furnished to it by the defendant was denied by the answer, the judgment was erroneous, since a public service company cannot be compelled to sell its product to an insolvent concern. (107 S. E. 226.)*

Rights of Utilities as to Abrogation of Rates.—In the course of the litigation over the increase of gas rates in New York City the Appellate Division of the New York Supreme Court has made the following pronouncement on the rights of utilities to abrogate existing contract rates—a question which had given rise to the dispute between the gas utilities and the municipality and on which the lower courts were in conflict: "The gas corporation may not legally assume to be vested with the rate-making powers and to be the arbiter of the adequacy and reasonableness of the rates. It may not assume power to decide these questions in its own favor and proceed to abrogate the contract whose benefits it has long enjoyed. It may not, of its own motion, say that it will no longer be bound by a contract because it has become unprofitable. The courts even will not relieve parties from hard bargains simply because they are such. The gas corporation has the same right to ask modification of the contract in the public interest that the municipality would have if the physical property and apparatus used by the corporation became insufficient or dangerous to health or if the rates in the course of time became exorbitant and unreasonable—the right to appeal to the sovereign state or its delegated agent having dominion over such matters. The corporation has no greater right than the municipality to determine for itself the merits of such a disputed question."

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Arthur B. West, who was elected president of the Pacific Coast Division of the N. E. L. A. at the recent convention at Del Monte, Cal., is vice-president and general manager of the Nevada-California Electric Corporation, a holding company for the following properties of which Mr. West is operating head: Southern Sierras Power Company, Nevada-California Power Company, Holton Power Company, Holton Interurban Railway Company, Interstate Telegraph Company and Imperial Ice & Development Company. Mr. West was born in Rochelle, Ill., in 1875 and was graduated from the Stanford University law school in 1899. He became in 1909 a member of the firm of Potter, West & Potter, attorneys for the Nevada-California Power Company, with offices in Denver. In 1911 he moved to California to become vice-president and assistant to the president and general manager of a group of utilities controlled by the Nevada-California Electric Corporation. Three years later, on the death of President and General Manager Delos Chappell, Mr. West succeeded him in office.

A. B. WEST

Charles E. Neil, editor of *Rate Research*, has also assumed the editorship of the *N. E. L. A. Bulletin*, succeeding H. M. Platt, who has become associated with the Society for Electrical Development. Mr. Neil, who formerly was rate expert for the Public Utilities Commission of Colorado, became editor of *Rate Research* about one year ago. He will continue his work with *Rate Research* under the supervision of Fred W. Herbert, superintendent of the N. E. L. A. service department, and in connection with the editorship of the *Bulletin* will be associated with the publicity department.

L. R. Nichols has been appointed resident manager at Oneida, N. Y., of the Adirondack Power & Light Company, Glens Falls, N. Y. Mr. Nichols succeeds West Gillson.

Frank J. Sprague, Elmer A. Sperry, Col. William Barclay Parsons and John W. Lieb were made honorary doctors of engineering recently at the fiftieth anniversary of the founding of the Stevens Institute of Technology, Hoboken, N. J.

Howard M. Raymond has been appointed acting president of the Armour Institute of Technology to fill temporarily the vacancy caused by the recent death of Dr. F. W. Gunsaulus. Professor Raymond is a graduate of the University of Michigan and is well known throughout the Middle West. He has been connected with the institute for the past twenty-six years and became dean of engineering in 1903.

H. G. Butler, Power Administrator under the California State Railroad Commission, resigned on July 1 to engage in private practice as a consulting engineer. In June, 1918, Mr. Butler was made Power Administrator by the commission to cope with the very serious situation that then confronted the state by reason of the protracted drought and the heavy wartime demand for power. Through his efforts co-operation of the various power companies was brought about, and by a program of rigid conservation the available power was so distributed that essential industries were fully taken care of and there was besides no serious public inconvenience. Mr. Butler was intrusted with the right arbitrarily to order connections, interchange of power, use of steam generation, change and shift of loads and in some instances curtailment of the use of power in less essential industries. Although clothed with such power, no complaint as to the justice of his orders was made to the commission either by the power companies or the consumers during his entire term as Power Administrator. Mr. Butler has completed eight years of service with the commission. He went to California to become the commission's first assistant engineer and after eighteen months was made assistant chief engineer. He had previously been employed in engineering work on the Panama Canal and in railroad and street-railway building in the Middle West.

W. R. Putnam, vice-president and general manager of the Idaho Power Company, Boise, Idaho, was elected to the presidency of the Northwest Division of the N. E. L. A. at the recent convention of that body. Mr. Putnam gained considerable prominence in the electrical industry a few years ago for his extensive studies of the electric range and its commercial possibilities. As chairman of the electric range committee of the N. E. L. A. his reports were always looked upon as the latest and most authoritative information on the subject. Mr. Putnam is a graduate of the University of Minnesota. For some time he was manager of the Red Wing (Minn.) Gas, Light & Power Company. In 1909 he became superintendent of the Menominee & Marinette Light & Traction Company, now part of the Wisconsin-Minnesota Light & Power Company. Two years later he went to Rapid City, S. D., to take charge of the construction of the hydroelectric plants of the Dakota Power Company on Rapid River. He next became connected with the Utah Power & Light Company, Salt Lake City, where as sales manager he displayed considerable executive ability. As a consequence late in 1916 he took on the additional duties of manager of the Salt Lake division of the company. Mr. Putnam has been engaged in his present duties in Boise for two years.

W. R. PUTNAM

Dr. Livingston Farrand, chairman of the central committee of the American Red Cross, formerly professor of anthropology at Columbia and at one time president of the University of Colorado, has been elected president of Cornell University, where he succeeds Dr. Jacob Gould Schurman, who resigned a year ago and whose appointment as Minister to China was confirmed about a month ago. Dr. Farrand was born June 14, 1867, and was graduated from Princeton in 1888. He received his doctor's degree in medicine in 1891. After two years of study abroad he returned to this country, joining the Columbia faculty. He has since then specialized in anthropology.

Darwin Curtis of the National X-Ray Reflector Company has sailed for Europe, where he will spend some time in the interest of his company.

Fred A. Anderson, formerly electrical engineer with the United States Shipping Board in San Francisco, has resigned that position to become sales engineer with the Safety Electric Company.

R. S. Holland, formerly in charge of the electrical sales department of the Capital Electric Company, Salt Lake City, Utah, has been promoted to the position of credit manager and will also act as secretary of the company.

W. I. Savidge, formerly with the Live Wire Supply Company, Macomb, Ill., has resigned from that firm to go into business for himself as an electrical engineer and contractor. He will also handle a special line of appliances. His headquarters will be at Macomb.

R. C. Cosgrove has been appointed manager of the farming section of the industrial department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Mr. Cosgrove has been actively in charge of this work for the Westinghouse company since the resignation of R. B. Harvey several months ago.

C. M. Heintz, formerly publicity representative of the Los Angeles district of the Westinghouse Electric & Manufacturing Company, has been appointed field representative of the merchandising bureau of that company and will supervise its merchandising and advertising activities in the entire Western territory.

R. S. Folland, who was formerly in charge of the electrical sales department of the Capital Electric Company, has been promoted to the position of credit manager of that company and will also act as secretary. Mr. Folland has been with the company for more than twenty years, serving in the capacities of secretary and sales manager.

J. M. Gilchrist, who was recently elected vice-president of the Federal Electric Company and the Federal Sign System, Chicago, has been with the Federal organization almost since its inception, joining it in 1901, soon after his graduation from college, as secretary of the company. He obtained the degree of electrical engineer at Cornell University, class of 1900.

Robert E. Rae, general manager of the Northwestern Electric Equipment Company, electrical jobber in New York City, has resigned to enter business on his own account. Mr. Rae was for five years sales manager of Stanley & Patterson (as manufacturers, not jobbers) and was for twenty-two years with the Western Electric Company. His position with the Northwestern Electrical Equipment Company will be assumed by W. M. Fallon, secretary and assistant treasurer, who will in addition to his other duties take charge of sales.

R. W. Stanley has been elected first vice-president of Rauch & Lang, Inc. Mr. Stanley was formerly general manager in charge of production and engineering.

John B. McFerran, Jr., formerly with the American Creosoting Company, has become associated with the Louisville (Ky.) Electric Manufacturing Company as secretary and treasurer and will also have charge of the sales end of the business.

H. G. Thompson, who resigned from the Edison Storage Battery Company in the fall of 1919 to form the Transportation Engineering Corporation, of which he was elected president, has been appointed sales manager of the American Radio Research Corporation, Medford Hills, Mass. Mr. Thompson has been identified with the storage-battery field for many years, particularly in its application to train lighting and other railway uses. He was born in Massachusetts in 1875, and at the age of twenty-one entered the em-

H. G. THOMPSON

ploy of the Pullman Car Company. Two years later he was advanced to be foreman of electricians. In 1905 he was employed by the Pennsylvania Railroad to take charge of car lighting at Jersey City. Later he became associated with the Safety Car Heating & Lighting Company, then with the railway department of the Westinghouse Storage Battery Company. In the spring of 1910 he joined the sales organization of the United States Light & Heating Company and later that year the Edison Storage Battery Company. He became manager of the railroad department and was elected vice-president of the company and in 1915 was appointed general sales manager.

A. J. Callaway has been appointed to succeed C. H. Talmage as manager of the Salt Lake City office of the Western Electric Company, Mr. Talmage having been granted a six months' leave of absence. Mr. Callaway has been assistant to Mr. Talmage for about a year.

A. C. Nelson, formerly of S. B. Condit, Jr., & Company, Boston, has been appointed New England sales manager of the Arrow Electric Company, Hartford, Conn. Mr. Nelson will make his headquarters at room 621, Rice Building, Boston.

A. W. Calendar has joined the Canadian sales staff of the Torrington Company, manufacturer of electric vacuum cleaners, with headquarters in Toronto. Mr. Calendar was formerly office manager of the Springfield (Mass.) needle plant of the Torrington Company.

C. H. Carter, formerly manager of the Los Angeles office of the Pacific States Electric Company and recently in the agricultural implement supply business at San Francisco, has re-entered the electrical business as head of C. H. Carter & Company, electrical jobbers.

C. H. Talmage, manager of the Salt Lake City office of the Western Electric Company, has received a six months' leave of absence and will become associated temporarily with the insurance department of the Columbia Trust Company of Salt Lake City. Mr. Talmage has been connected with the Western Electric Company for twenty years.

James Dixon, who for the last year has been production manager of the Reliance Electric & Engineering Company of Cleveland, Ohio, has been appointed works manager. Mr. Dixon is a graduate of Columbia University and a member of the A. I. E. E. Prior to his association with the Reliance company he was connected with the Crocker-Wheeler Company as superintendent of construction, assistant chief engineer and works manager of the small-motor department. He has been a frequent contributor to the pages of the ELECTRICAL WORLD, chiefly along the lines of industrial applications. During the world war he was a junior lieutenant in the United States Naval Reserve.

John L. Pratt has been appointed general manager of the accessory division of the General Motors Corporation, Detroit, with headquarters in New York City. This relieves Alfred P. Sloan, Jr., vice-president of the corporation, of direct supervision over the activities of the following accessory units: Hyatt Roller Bearing Company, Remy Electric Company, Jaxon Steel Products Company, Dayton Engineering Laboratories, Harrison Radiator Corporation, Lancaster Steel Products Company, New Departure Manufacturing Company, United Motors Service, Delco Light Company, Klaxon Company, Champion Ignition Company, Frigidaire Corporation and Dayton-Wright Airplane Corporation. Mr. Pratt was formerly special assistant to the president of the corporation and chairman of the inventories committee and the appropriations committee. Prior to becoming connected with the General Meters Corporation he was director of the motors development division of E. I. du Pont de Nemours & Company, Inc.

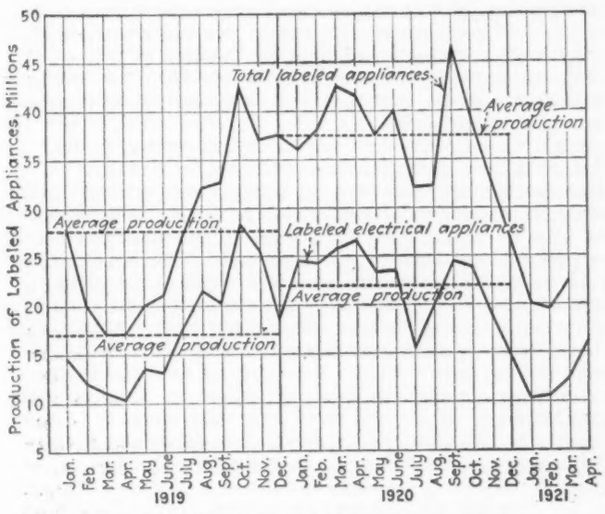
Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of
Electrical Apparatus and Supplies

Return of Production Shown in Underwriters' Curves

THE Underwriters' Laboratories, Inc., in its April issue of *Laboratories Data* printed a chart which is reproduced below showing by a graph the production of labeled appliances during the years 1919, 1920 and through March, 1921. To this has been added a graph showing the production of labeled electrical appliances for the years 1919 and 1920 and through April, 1921.

In making up the total graph approximately 100 industries and 1,300 factories were taken into consideration,



PRODUCTION OF LABELED APPLIANCES INCREASING THIS YEAR

the factories represented being situated as far north as Calgary, Alberta, Canada, as far south as Galveston, Tex., west as far as San Francisco and east to Boston. In forming the curve of labeled electrical appliances about fifty industries were represented, and figures were taken from points as widely separated as those mentioned above.

The two curves follow each other in their ups and downs very evenly, keeping apart to the extent that the electrical labeled appliances run from 40 to 60 per cent of the total labeled. It is interesting to see how closely the production of labeled electrical appliances follows that of other labeled appliances in the construction field. Furthermore, there stands out clearly the sudden rush of business in September, 1920, just prior to the break, and the turn in production this year. After the steep decline ending in January, February almost held its own and the sharp advance in March was continued through April.

One-Design Lighting Fixture Plug and Receptacle to Be Made

ONE of the foremost steps in standardization has been taken by manufacturers of attachment plugs and receptacles for lighting fixtures by eliminating the soldered joint necessary in present-day attaching and hanging of chandeliers, etc. Arrangements have been made by eleven representative manufacturers of attachment plugs and receptacles whereby this fixture plug and receptacle will be made according to a set of models which have been accepted as standard. Up to date only the one set of models is available, but it is expected by the manufacturers that by late fall or early winter they will have their own dies and other necessary apparatus so that production can be started by that time.

For some months manufacturers have been conferring among themselves on the matter, satisfied on the one point that the best interests of the trade would be met only by a single standardized unit for the electrical and mechanical connections in the attaching and hanging of lighting fixtures, both side-wall and ceiling. Out of these meetings there has finally come a harmony of action whereby the best features of all the designs submitted by different producers have been combined in the types selected under the name "Elexit." One type has been developed for ceiling attachment, but this is adapted for flush or raised work and can be used with one of several styles of canopies, depending on conditions that will be met in existing outlet-box installations. With the flush plate the canopy used is of miniature size. The suspending hook supports the weight of the fixture.

In the side-wall unit ample provision is made in the one type for support of the fixture, ease of adjustment and ease of removal. A small oval flush plate is provided for small types of fixture.

Tariffs on Electrical Goods Provided in New Bill

THE Fordney tariff bill, designed to afford full protection to American industries, was formally reported into the House of Representatives on June 28. It is thought that under this measure duties will be in the neighborhood of 30 per cent higher than under the existing tariff. Splitting of duties is common and the American valuation plan is the basis of lists. Paragraphs referring to the electrical industry are printed below:

Mica, unmanufactured or rough-trimmed only, 6 cents per pound and 17 cents ad valorem; cut or trimmed, splittings, plates, built-up mica and all manufactures of mica or of which mica is the component material of chief value, 12 cents per pound and 17 per cent ad valorem; ground mica, 6 cents per pound and 20 per cent ad valorem.

Carbons and electrodes of whatever material composed and wholly and partly manufactured, for producing electric arc light; electrodes of carbon or graphite for electric furnace or electrolytic purposes; brushes for electric motors, generators, etc.; plates, rods and other forms for making into brushes; other wares not especially provided for, 35 per cent ad valorem.

Incandescent electric light bulbs and lamps, with or without filament, 35 per cent ad valorem.

Storage batteries and parts and materials, 30 per cent ad valorem.

Anti-friction balls and rollers for ball and roller bearings, and parts, 35 per cent ad valorem.

Aluminum, scrap and alloys in crude form, 5 cents per pound; in plates, sheets, bars, etc., 9 cents.

Copper wire not coated nor covered and also tin-coated, 1½ cents per pound; in rolls, rods or sheets, 2½ cents; seamless tubing, 7 cents; brazed tubing, 11 cents; brass wire, rods, sheets, etc., 4 cents per pound; seamless tubing, 8 cents.

Telephone, light, power or railway poles of cedar or other woods, 10 per cent ad valorem.

Asbestos paper and millboard of long-fiber asbestos and electrical papers not exceeding 0.05 in. thick, 8 cents per pound; of other asbestos fibers, 1½ cents; sheets and plates not exceeding ⅛ in. thick, 1 cent per square foot, up to 2½ cents for over ¼-in. thickness.

Electrical insulators and other articles wholly or partly or in chief value of shellac, copal or synthetic phenolic resin, not especially provided for, 30 per cent ad valorem.

New Ruling on Marking Goods for Canada

THE National Association of Purchasing Agents, New York City, is calling the attention of its members to a new ruling in the Canadian customs act which will become effective on Oct. 1 next. The ruling is as follows:

"12-a. That all goods imported into Canada which are capable of being marked, stamped, branded or labeled, without injury, shall be marked, stamped, branded or labeled in legible English or French words, in a conspicuous place that shall not be covered or obscured by any subsequent attachments or arrangements, so as to indicate the country of origin. Said marking, stamping, branding or labeling shall be as nearly indelible and permanent as the nature of the goods will permit."

The penalty for non-observance of this ruling is an additional 10 per cent on the value of the goods.

30,000 "Already-Built" Minneapolis Homes Wired in Eight Years

TWENTY-ONE Minneapolis homes are wired every day, on an average, according to figures supplied by contractor-dealers of that city. This rate of installation has been maintained for the sixteen-month period including all of the year 1920 and the first four months of the current year, the compilation being made on figures available up to May 1, 1921. In the last eight years more than 30,000 "already-built" Minneapolis homes have been wired, according to these figures, in addition to the many homes wired while in the course of construction.

The steady, rapid growth of the electrical industry and the general use of electricity in the homes is emphasized by a comparison of the rate of wiring in the various years of the period from 1913 to 1920 inclusive. In 1913 755 already-built homes were wired in Minneapolis. That was an average of slightly more than two a day. In 1920 6,300 old residences were wired, an average of twenty-one a day and about ten times as many as were wired seven years before.

To the middle of May this year more than twice as many homes have been wired as were wired in the whole of 1913. This is slightly below the average set for 1920, but it is significant in view of two facts, that there is an industrial slump and that there is an ever-increasing number of houses not on the wiring market because they are already wired. The rapid progress in wiring activities is attributed to the fact that whereas electricity was formerly installed for lighting only, today there are innumerable other domestic needs for it.

Birmingham District Shows Gradual Awakening

ON THE whole business is showing an increase in Birmingham and in the Birmingham district. During the past few weeks announcement has been made that several shops and factories which have been closed down for some time will open up during the next few weeks. The opinion prevails that there will be a general revival of business commencing early in September, when, it is felt, the cotton crop should begin to move and a number of industries be placed in operation.

A considerable amount of Birmingham steel rails is now being shipped to Japan, 5,000 tons having been shipped on one order alone. Other big orders to Japan and the Orient are to follow. The amount of coal now being mined in the Birmingham district is somewhat below normal, but it is believed that with the approach of the fall season the output will be greatly increased with the receipt of heavier orders due at the mines.

There is quite a volume of building activity in the district, and this has had a tendency to stimulate the trade in electrical wiring and electrical equipment of various kinds. While the electrical dealers announce that business is below normal, still they say their trade is holding up fairly well, and they also look for an increase in business with the coming of the fall season. Dealers in vacuum cleaners, washing machines and other electrical appliances are well stocked on these goods. They say that business has decreased considerably during the past few weeks, but they are optimistic and are holding to the opinion that their trade will open up better within a few weeks.

The Southeast as a Market for Radio Apparatus

AN INCREASING interest in Atlanta and its vicinity in amateur wireless sets is worthy of comment, and the more progressive jobbers have realized the fact that an excellent potential market awaits development. They are therefore engaged in developing channels for a wider distribution. There are several campaigns proposed and designed with the idea of stimulating the sale of this equipment, especially in the city of Atlanta, whch has become virtually the radio center for the amateur wireless operators in the Southeast.

Manufacturing concerns having plants scattered over a wide area are seriously considering the installation of wireless-telephone equipment for communication between the respective plants, and experiments are being conducted with the idea of substituting this type of communication for the present long-distance telephone calls. The hope is that business can be transacted over the wireless telephone at certain times of the day more satisfactorily and economically than by means of the regular toll lines. Should the scheme prove practicable, it is probable there will be a broad market opened up for this class of material as there are a large number of executive offices in Atlanta with manufacturing plants scattered over the territory within a radius of 100 miles of that city. The experiments, therefore, are being watched with considerable interest.

The Metal Market Situation

CONDITIONS remain about the same in the copper market. Prices are without essential change, with large producers still loath to sell July copper under 13 cents per pound, though occasionally going under this, it is reported. In the outside market spot shipment copper is available at 12.75 cents delivered, July at 12⅞ cents and August at 13 cents.

Official price on lead is still held at 4.40 cents in New York although the market is about 4.50 cents and is firm.

The Bethlehem Steel Company has announced a reduction of from $4 to $10 on steel products, effective July 5. Producing costs are stated to be no lower.

NEW YORK METAL MARKET PRICE

	June 28, 1921	July 5, 1921
Copper	£ s d	£ s d
London, standard spot	70 5 0	72 5 0
	Cents per Pound	Cents per Pound
Prime Lake	13.00	13.00
Electrolytic	12.87½—13.00	12.87½—13.00
Casting	11.87½	11.75—11.87½
Wire base	15.00—15.25	15.00—15.25
Lead, trust price	4.40	4.40
Antimony	4.75	4.75
Nickel, ingot	41.00	41.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Zinc, spot	4.75	4.85
Tin	29.12½	29.87½
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.00	9.25—9.50
Brass, heavy	4.75— 5.00	4.25—4.50
Brass, light	4.00— 4.25	3.50—3.75
Lead, heavy	3.50— 3.62½	3.25—3.50
Zinc, old scrap	2.50— 2.62½	2.00—2.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

ACTIVITY in the supply trade continues on a spotty basis. Building of residences is holding up well in the Intermountain, Northwest and New England territories. In St. Louis the trade is quiet, and in New York activity is not especially noticeable. The movement of fan motors has been good all over the country as a result of the warm weather commonly experienced.

Reduction of export rates on the Pacific Coast is expected to help cities there. Lowering of freight rates on iron ore consigned to the St. Louis district is expected to help the industries in that region. There is increased activity in textile mills in New England. Heating appliances are moving well in Chicago. Ranges are picking up. Pins and poles and cross-arms are being bought a little better around St. Louis. There, however, business is virtually on the decrease.

Unemployment is quite noticeable in several sections of the country although it is not at this time serious in its nature. New York, St. Louis and the Intermountain regions report this as a feature.

Effective July 5 the Bethlehem Steel Company issued a new schedule of prices showing reductions varying from $4 to $10 per ton on its steel commodities. The desire to re-establish conditions in the steel trade rather than any reduction in manufacturing costs is given as the reason for the cut.

NEW YORK

Fans are about the only really active item in the electrical trade in this territory at present. General business has not picked up appreciably, though the consensus of opinion is that it will show an improvement in the fall months. Non-employment is existent to a very considerable extent. Collections show no change, being good with some but slow with a great many more. Price cutting is very general and keenly competitive conditions rule today. A feature of this is the advent of two new supply-jobbing houses in New York City. Inventories are being held low and buying is only for maintenance.

Building construction plans in this section continue to show encouraging gains, according to the Dodge reports, but on Manhattan and nearby there is little actual building work under way other than some of a speculative character. The chief obstacle to normal activity is felt to be the existing high wage scale of building mechanics. The first action leading to a remedy of this condition has been taken, however, which calls for a meeting of employer delegations from each trade group with labor representatives. It is proposed to obtain definite statements regarding the attitude of the various trade unions on reducing wages. In view of the prevalence of non-employment in the industry it is rumored that a cut of at least $1 per day would be accepted.

Schedule Material.—Price reductions have aided demand some, especially on sockets, but this is largely felt to be but temporary, as stocks ran low anticipating a price decrease.

Lead-Covered Wire.—Small stocks are carried and there is not much call. No. 14 duplex, lots of 1,000 ft., sells for about $35 per 1,000 ft.

Metal Molding.—A good supply is held, but not much is moving. In 1,000-ft. lots the three-wire to four-wire size sells for about $6.90 per 1,000 ft.

Switches.—A change in the list and discounts on safety switches by one manufacturer make a price decrease of about 20 per cent, effective July 1. A representative open switch, single-throw, two-pole, 30-amp., fused, is listed at $1.06 each with about 10 per cent discount in lots of a dozen. Demand for both types is spotty, with a good supply held.

Dry Cells.—Price reductions have stimulated buying somewhat, and there is a fair vacation demand. In barrel lots No. 6 regular sells for 29 cents each and igniters at 30 cents each. Good stocks are on hand.

Panel Boxes.—Very few are carried in stock, for manufacturers can make one-day deliveries. There is little call, however, and prices are unchanged recently.

Flexible Armored Conductor.—The general situation is very quiet, though one or two jobbers report better sales. The usual selling price of No. 14, two-wire, single and double-strip, is $55 per 1,000 ft. in that quantity, though this price ranges down to $50. A good quantity is carried.

Conduit.—In 2,500-ft. lots prices are as follows: Black, ½-in., $58.75 to $63.50; ¾-in., $76.38 to $83.75; 1-in., $109.85 to $118; galvanized, ½-in., $63.34 to $68.68; ¾-in., $82.59 to $90.62; 1-in., $118.03 to $128. The sentiment among jobbers is that further price decreases will be made. Demand is poor and stocks are fair.

Rubber-Covered Wire—From $6.50 to $7 per 1,000 ft. is the current price of No. 14 single-braid in 10,000-ft. lots, but stocks are more than adequate as sales are slow.

Power and Light Outfits.—Effective July 1, the Western Electric Company has made reductions on its plants ranging from $60 to $190 each, depending upon which of eight types is considered.

CHICAGO

Last week prospective work took a jump and permits to the extent of $2,700,000 were issued, the highest in seven weeks. Now, however, with the wage ruling still indefinitely postponed and with the carpenters refusing to be bound by the arbitration proceedings, things are about as quiet as ever. A decision in regard to the new wage scale is expected any day and should be followed by a season of activity. Such a result would be of immediate benefit all along the line in the electrical industry as all hands are carrying light stocks. With the exception of heating appliances, especially of the better class for gift purposes, all retail trade is quiet. This condition is general throughout all lines, the shrinkage in electrical demand being perhaps less than that experienced by other specialty merchandise lines.

The vacation season is fairly on and all houses seem content to handle current business in a routine way, reserving their effort for the better days which are felt to be approaching in the fall. There is nothing of importance reported in regard to price changes or special electrical activity.

Wire.—Reasonable quantities of bare copper wire are moving at the unchanged price of 16½ cents per pound for No. 8 in 1,000-lb. lots. Insulated wire is also unchanged in price and is very quiet owing to the lack of new building construction. Some weatherproof is being bought by central-station companies. Rubber-covered, at $7 per 1,000 ft. in 10,000-ft. lots, is unchanged.

Conduit.—Construction demand is very light, and demand for both black pipe and flexible conduit is correspondingly slow. Price uncertainty continues, with the larger concerns holding to the old quotation of $59 per 1,000 ft. for ½-in. black conduit in 5,000-ft. lots. Flexible non-metallic conduit is quoted as representative at $22.75 per 1,000 ft. for the ½-in. size in 1,000-ft. lots.

Lock Nuts and Bushings.—Demand is not so good as was noted a month ago. Rewiring jobs are plentiful but are not in sufficient volume to make good business. While some shading is reported leading jobbers adhere to a quotation of $1 per 100 on lock nuts and 1.85 cents on bushings. Stocks are being held by jobbers to about a thirty-day supply at the present rate of consumption.

Percolators.—Throughout the month of June business has

been excellent in percolators, some dealers and jobbers actually having difficulty in supplying the demand, particularly for the nine-cup size. Prices are unchanged, but in spite of that the complaint that they are too high, which was frequently heard a month ago, is no longer voiced.

Ranges.—Continual effort at publicity is having its effect and manufacturers are reporting fair business. The excessive heat of the present season favors the pushing of this line, and many dealers are maintaining permanent demonstrations with excellent results.

Fans.—Warm weather is keeping the demand up, particularly for the 6-in. inexpensive type and the 16-in. oscillator for office use. Prices are rigidly adhered to all along the line, and while no difficulty is experienced in filling the demand, business is good. Sales are generally for lots of one or two rather than for large installations.

Motors.—Jobbers state that things are quiet, yet all manufacturers report some business. Orders are largely restricted to the smaller sizes, and those for industrial use are going to concerns that are getting rid of the old line-shaft drive and installing direct-connected motors.

BOSTON

Trade was quiet last week, the holiday period tending to postpone business. Building and engineering contracts placed in New England increased more than $1,000,000 during the week ended June 28, compared with the previous seven days. The total was $4,196,900, comparing very favorably with the same week in recent years with the exception of 1920. Jobbers are slowly beginning to buy manufactured products, as in some lines stocks have now been pretty well liquidated. Prices changed very little during the past week. Collections are rather slow and are being followed up closely. Deliveries are good in all lines. New England textile mills are fairly active and in the rubber industry conditions are improved. It is reported that one large woolen organization is running at 80 per cent capacity, and one of the largest cotton-cloth establishments is working full time with 16,000 employees, some overtime also being required. Labor is still in process of liquidation.

Flexible Armored Conductor.—Movement is slow, with ample stocks. No. 14 single-strip sold at $52 per 1,000 ft. in 5,000-ft. lots before the week end.

Lamps.—A leading distributer reports business within 25 per cent of normal. Mill-type tungsten lamps are in good demand and flashlamps are selling well. Prices are steady.

Meters.—A moderate demand is reported and house-wiring campaigns are yielding good results in various localities.

Ranges.—Demand is spotty, some representatives reporting dull market conditions and others increased activity. Several carload orders have been received lately by a prominent range manufacturer who also reports a good small-lot business. A representative retailer reports selling about twenty ranges per month at present.

Fans.—The recent hot weather stimulated fan sales and reduced stocks considerably. One distributer sold 2,500 fans in about three days. This spurt subsided quickly and stocks are still ample.

Industrial Lighting Portables.—Considerable interest in industrial lighting apparatus is evident during the present period of plant rehabilitation. A leading specialty in the portable line is selling at $12 per unit to dealers.

Flatirons.—Improved demand is reported. Distributers' stocks are lower and some buying has set in, although not of large volume.

Washing Machines.—A better market is apparent for the time being. One distributer reports it difficult to maintain more than a nominal stock.

Wire.—Slightly improved demand is reported. No. 14 rubber-covered wire is selling at $6.35 per 1,000 ft. in 5,000-ft. lots and No. 6 weatherproof at 21.5 cents per pound in 100-lb. lots. Bare base is 16 cents with dull sales.

Rigid Conduit.—Good stocks with light movement, somewhat better than a few weeks ago, are reported. On ½-in. black $62.18 is being paid the jobber per 1,000 ft. on less-than-carload lots, and the galvanized is moving at $67.21 in this size.

Motors.—A few sales are being handled, mostly in small units. Prices are steady in the main. Stocks are more than equal for all normal requirements along standard-design lines.

ST. LOUIS

Efforts are being made to get the cost of building down, but only meager results have been attained so far. A number of wage contracts in the building trades expired on July 1, and contractors are endeavoring to effect a reduction. Some decrease will probably be agreed upon, but it is not expected to be large. Several million dollars of construction work are reported to be awaiting lower building costs. A freight-rate reduction on iron ore from the Michigan-Wisconsin ranges to the St. Louis district, just ordered by the Interstate Commerce Commission, is expected ultimately to be of considerable benefit in building up this territory industrially. The rate was cut from $4.05 to $3.25 per ton, placing this district on substantially the same basis in the steel industry as Pittsburgh. Only recently, with the development of a process of coking Illinois coal, has St. Louis entered the steel-refining field.

Business generally in this territory is showing a tendency to decline. Purchasing is on a much more cautious basis than prevailed a few weeks ago. Industries are reducing operations and non-employment is increasing. Electrical jobbers and dealers are beginning to feel the effect of the change. Most of the jobbers report no change in demand, but some find a slight decrease. As an example of the cautious buying one jobber reports that he received nine orders for fifteen fans in one day from a dealer that would ordinarily buy at least fifty at a time. However, some improvement is found in the South as the farmers have placed more acreage this year in other products than cotton and the prospects point to a good yield. Cotton is being gradually marketed and the buying power of the South has increased.

Fans. — Steady demand continues owing to the warm weather prevailing throughout this entire territory. Jobbers are maintaining their prices, but some dealers, principally department stores, have made heavy reductions.

Heating Appliances.—These are moving rather slowly, though some seasonal increase prevailed in June. The reductions announced for July 15 have had no appreciable effect upon the demand. Stocks are maintained by every one on a very conservative basis.

Poles and Cross-Arms.—A reasonably good demand in these items continues, the demand being for small extensions on the part of the utilities. The large jobs contemplated this spring show no signs of materializing. Present quotations on 3¼-in. x 4¼-in. Rainier fir arms, f.o.b. St. Louis, in amounts exceeding 1,000 linear feet, are: 4-ft., $53.90 per 100 arms; 5-ft., $67.38; 6-ft., $80.86; 8-ft., $107.81; 10-ft., $134.76.

Locust Pins.—Pins, 1¼ in. x 9 in., are quoted as follows: In quantities less than 1,000, $46.70 per 1,000; 1,000 to 2,000, $41.20; 2,000 to 3,000, $38.90; over 3,000, $36.60. The demand is good and stocks are reported to be in good shape.

Insulators.—Immediate delivery can now be given on porcelain insulators either from the factory or from local stocks. The demand remains on a parity with that for the other pole-line materials. No price changes have been announced since the general price level started downward. It is the opinion of some that the prices should be lowered but that the reduction would not materially effect the demand.

Lamp Cord.—Large stocks are still reported by the jobbers, and the demand shows no improvement. No. 18 twisted cotton is quoted at $15 to $16.50 per 1,000 ft. in 5,000-ft. lots and No. 18 twisted silk at around $23.

Tape.—Demand for both rubber and friction tape continues reasonably good. Local stocks are being kept on a low basis by most jobbers. Friction tape is selling at 50 cents per pound in small lots down to 35 cents to 36 cents for 100 lb. or more. Rubber tape brings about the same prices.

Wire.—It is reported that there is no change in the call for wire and No. 14 rubber-covered is the best seller. It continues to be quoted at $6.75 per 1,000 ft. in 5,000-ft. lots, though somewhat better prices are sometimes made if the size of the order is sufficiently attractive.

ATLANTA

Business for the month of June continued to hold out to the extent that this month was the best of the year, with the possible exception of March. The tone of business in general is improving and jobbers are in a more optimistic mood than has been evident for several months past. The number of orders continues to increase though the volume of the individual orders is considerably below that of a year ago and inquiries for heavy purchases are in evidence. The report of the Sixth Federal Reserve Bank shows considerable activity in the building line, particularly in Jacksonville, Knoxville, Nashville, Birmingham and Montgomery, while the permits in Atlanta for June number 335, valued at $855,716. The local building inspector states that if the present rate of construction of residences is continued for the balance of the year, 1921 will provide for 1,600 new homes.

While collections show a slight improvement there is little ready money in the rural districts; banks reporting through the Federal Reserve Bank show that 90 per cent to 100 per cent of the agricultural paper is being renewed as it comes due and in all probability this condition will continue until fall harvest. The settling of the marine strike has permitted shipping conditions in port towns to return nearly to normal.

Washing Machines.—Little or no activity is to be observed in this line and stocks remain very heavy in spite of reduced prices offered by retailers.

Electric Fixtures.—To date the fixture business has been the best on record, particularly for the moderate priced residential type, though commercial fixtures continue to move very well. Stocks are reported in good condition with no reductions in price.

Storage Battery Charging Sets.—This specialty has shown a little life recently but orders continue far below those of the corresponding period of last year. Stocks are very heavy and no immediate price reductions are in prospect.

Safety Switches.—A price reduction ranging from 20 per cent to 25 per cent became effective July 1. Practically all of the larger towns have adopted ordinances requiring safety switches and this is creating an active market. Anticipation of this situation accounts for excellent stocks throughout the section.

Vacuum Cleaners.—Summer weather has served to create a brisk market in this line, sales and inquiries being in better volume than for any other time this year.

Heating Devices.—Jobbers are notifying the trade of a reduction in price of from 10 per cent to 15 per cent on heating devices to become effective on July 15. The jobbers anticipate that this cut will serve to move some of the heavy stocks they have on hand.

Ventilating Fans.—This has been an excellent year for ventilating fans and the public seems to have awakened to the utility of adequate ventilating apparatus. Stocks are in fair condition, but factory shipments are necessary in many instances.

Fans.—The continued hot weather has revived the movement of desk fans and the outlook for the disposal of stocks is much better, although one or two jobbers are likely to carry over a surplus. Ceiling fans are somewhat slow, due to so-called high prices.

Churns.—The territories in and around the smaller towns are taking a fair allotment of electrically driven churns and the movement is quite steady. Stocks are in good shape and no price reduction is in sight.

Outlet Boxes.—Little activity is to be noted in this line, the movement being steady but rather sluggish. All jobbers have excellent stocks on hand.

SEATTLE—PORTLAND

In the Seattle and Puget Sound district trade in electrical materials, with the exception of those used in smaller construction, continues to hold a quiet course. Throughout the district as a whole bright weather has been helpful to retail buying, especially from stores which include electrical shops. Erection of homes in this district continues on the increase, owing not only to the urgency of the housing situation but also to the decreasing costs of lumber and other constructional materials as well as labor. Advices state that reduction in export rates which will assist Seattle and other Pacific Coast cities materially in their fight to rebuild their trade were agreed upon by executives of various railroads in a recent conference. The reductions cover a long list of commodities ranging from 5 to 33⅓ per cent and will apply from all points east of Chicago.

The changes to be made will tend to restore the parity formerly existing between the export rates via the Transcontinental route and the Panama Canal route and should bring to Pacific Coast cities by rail for trans-shipment to the Orient much export freight that otherwise would go by all water route through the canal.

The state Department of Labor and Industries, which recently made a survey of the Washington coal industries in an effort to settle a strike that has been in effect since March 15, recently stated that mine workers must accept wage reductions and mine operators must reduce corresponding overhead cost of mining to enable Washington coal mines to reopen and produce coal at a price that will permit competition with foreign coals and fuel oil sold in this market.

Motors.—Light buying of small motors for replacements and betterments in local lumber and shingle mills during the midsummer shutdown was reported this past week. From indications the motor business, which has been far below normal, has turned the corner toward a noticeably better demand. Stocks are in good shape, and there are many second-hand motors in the market.

Knobs and Tubes.—Movement is showing a nice increase; stocks are ample and prices are tending downward, although the decreases are almost negligible.

Hollow Ware.—With the advent of warm weather and increased use of toasters, chafing dishes, etc., the retail market particularly is showing improvement.

SALT LAKE CITY—DENVER

Building operations in the large city centers are one of the best indications of business at the present time. A gain of more than 50 per cent in money invested in these operations is recorded for the month of June this year over the corresponding month of 1920. This increase, in spite of the heavy reductions recorded in building prices as compared with a year ago, is considered a certain indication of general improvement industrially. Construction work consists of small contracts, and there are almost no big jobs under way. This fact, however, lends especial significance to the showing.

New homes continue to be in big demand, and the mortgage firms report ample money for conservative loans on residential construction. Electrical contractors are experiencing a corresponding impetus in their business. They report an unusual demand for wiring jobs that provide ample outlets for the attachment of electrical conveniences and a good diminution of the use of the lamp socket for all sorts of connections, a healthy tendency just in its inception.

Dealers say there is a considerable movement on hollow ware, although the demand is still away below normal. No shortages of stocks are reported, but there is still a persistent tendency to stock small orders. Jobbers are unable to unload in sizable consignments. Non-employment is still a problem to reckon with in the Intermountain region. The farms could readily absorb thousands of idle men if money were available to pay them for their services. Farmers find it utterly impossible to get advances on their crops, the marketing of which is at present an uncertain quantity. There are no serious labor disputes at the present time in the region.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Factory for Quasi-Arc Weldtrode Company

The Quasi-Arc Weldtrode Company, Inc., Atlantic Avenue and Warwick Street, Brooklyn, N. Y., announces that since July 1 it has been in its new quarters at 114 Hudson Avenue, Peekskill, N. Y. In the new location, which is adjacent to both the New York Central Railway and the Hudson River piers, the company has not only much better shipping facilities than before but also better arrangements and machinery for the manufacture of its "weldtrodes."

The new works will also be completely equipped for the manufacture of all arc-welding accessories and for the building of the entire line of welding apparatus, including controllers (for both alternating and direct current) and welding generators driven by belt, direct-connected motor or gas engine.

Centrifugal Production for Arrow Pump Company

The Arrow Pump Company, with general sales offices in the Buhl Building, Detroit, announces that it is now prepared to manufacture centrifugal and other rotating types of pumps in which there will be incorporated a unique design of packing gland with ring oiling principle.

Frigidaire Plant to Be Moved from Detroit to Dayton

Following the announcement of the consolidation of the Frigidaire Corporation and the Delco-Light Company, both subsidiaries of the General Motors Corporation, Detroit, Robert H. Grant, general manager of the consolidated companies, states that the manufacturing plant of the Frigidaire Corporation will be moved within the next few months from Detroit to Dayton.

New Organization to Make and Distribute Safety Goods

The Standard Safety Equipment Company, 168 North Michigan Avenue, Chicago, has been organized to manufacture and distribute electrical and mechanical safety equipment and supplies, embracing gloves, linemen's blankets, first-aid cases, etc. C. A. Kingsbury and L. W. Dickson, both formerly with F. A. Hardy & Company, are respectively president and secretary. F. L. Hurlbutt, for the last ten years safety engineer of E. I. du Pont de Nemours & Company, is treasurer and in addition will have charge of all service work. A. U. Barnes of the Hardy company has been appointed Eastern manager with offices in the Clinton Building, Newark, N. J. There is also a Detroit office at 414 West Grand River in charge of O. L. Smith. A Cleveland connection and stockroom is under consideration. In addition to safety supplies the company will market a full line of welding equipment. "Standardize for safety" has been taken by the company for a slogan.

Diamond Holfast Rubber Plans to Erect New Factory

The Diamond Holfast Rubber Company, 33 Auburn Street, Atlanta, Ga., manufacturer of friction tape, fan belts, etc., has purchased a site of eleven acres of its proposed new factory for the manufacture of its "Diamond Holfast 2-plex" insulating tape, for which it was granted a patent last February. At present the company produces about 2,000 lb. per day of the insulating tape. On completion of the new factory it will be able to turn out a much increased quantity.

Report of Hurley Machine Company for 1920

When the balance sheet of the Hurley Machine Company, Chicago, manufacturer of Thor washing and ironing machines and vacuum cleaners, was made up for the year ended Dec. 30, 1920, total assets were shown to be $7,335,044. This figure included inventories of raw material, work in progress and finished stock to the amount of $1,797,390 and a figure of $1,201,704 for notes and accounts receivable (customers'), less reserve for doubtful accounts. Outstanding common stock amounted to $4,707,405 and preferred stock to $376,600.

Net income, after providing for federal taxes, amounted to $706,663; net profit was $1,489,731. Gross profit amounted to $2,740,928 after deducting $6,087,095 as total cost of sales from $8,828,024, the figure of net sales. Gross sales were $9,082,959. An amount of $189,433 was written off the inventory account because of reductions in cost or market value.

F. J. Ryan Acquires Electric Furnace and Selling Rights

The electric furnace department of the Lancaster (Pa.) Iron Works has been acquired by F. J. Ryan & Company, Philadelphia, who have also taken over the selling rights in North, South and Central America for the electric furnace developed by the Bario Metals Corporation.

C. D. Parker & Company, Inc., Moves to New Home

C. D. Parker & Company, Inc., investment bankers and controlling managers of central station properties at Amesbury, Palmer, Plymouth, Franklin, Great Barrington, Marion and Provincetown, Mass., and elsewhere, have moved from 67 Milk Street, Boston, to a remodeled six-story office building at 150 Congress Street, in the heart of that city's banking district. Offices of the banking house are on the street floor, and the legal department, power engineering department and other offices are on the sixth floor.

Winding-Spool Manufacturer in Production

The American Wood-Working Company, Chicago, manufacturer of winding spools, has announced that it has started production on its patented metal-covered spool and is in a position to make immediate deliveries.

Enlarged Distribution of Motors by Roth Brothers & Co.

Roth Brothers & Company, Chicago, in expanding their contact with the trade, have added the following firms to their list of distributers: W. H. Shirey, Dime Bank Building, Detroit; H. B. Squires Company, Pacific Coast representative, San Francisco; J. E. Chamberlain, 613 Lincoln Building, Philadelphia. After a recent swing around the branch offices of the company R. H. Barber, sales manager of the company, reported business somewhat slow but was satisfied that there were sufficient indications that it would improve considerably during the fall.

Benson Electric Company Opens New York Office

The Benson Electric Company is opening a New York office at 44 Dey Street, in charge of Edward Knapp, to engage in contracting, retailing and jobbing. The company manufactures electric steering gear for steamships, whistles and flashlights under the thirty-three patents held by M. B. Benson, president. The main office and factory is at Superior, Wis., and a store is also maintained at Superior and at Duluth, Minn. Besides its selling end the company engages in wiring houses, steamships, piers, etc., and also substation work, having just completed construction of the Raritan Valley Hydroelectric Company's plant and transmission lines in New Jersey. Under the laws of Minnesota the company was capitalized at $150,000, which was increased to $1,000,000 last week under Delaware law. A staff of specialty and sales engineers will be maintained at the New York office, where a stock of lamps, wire, conduit, appliances, motors and other electrical goods will be carried. A display room will feature the "Benson" electric telemotor for steering ships, of which more than 200 have been sold to the U. S. Shipping Board.

New Quarters for Maker of Power-Plant Piping

The M. J. Dougherty Company has completed and moved into its new quarters, which occupy the block from Twenty-fourth to Twenty-fifth Street at Washington Avenue in Philadelphia. These increased facilities for the fabrication of piping of every design, the company says, enable it to offer prices and deliveries which had never before been possible with its smaller factory.

Increase in Representation by E. O. McDowell

The item appearing on page 1516 of the June 25 issue should have referred to E. O. McDowell and not E. O. McDonald, manufacturers' representative at 30 Church Street, New York City.

Worcester Electric Tool Takes Over Three Companies

The Worcester Electric Tool Corporation, Worcester, Mass., has recently been organized to take over the business of the Stenman Electric Valve Grinder Company, Inc., the Stenman Electric Tool Company and the Consolidated Machine Tool Company, all of Worcester. The principal products of the company for the present will be the "HusKee" three-in-one combination service tool and the "HusKee" service drills. These tools have been on the market in a small way for the past six months and are the result of over two years' development work. The officers of the company are: H. P. Gleason, president; A. G. Sandberg, treasurer; J. J. Kelleher, sales manager, and Harold Raine, advertising and service manager.

Buffalo Forge Company Remodeling Fan Shop

The Buffalo Forge Company, Buffalo, which in 1917 started the conversion of its factory into a brick and steel sawtooth construction building, extending it over 116,023 sq.ft. of working area, including 44,916 sq.ft. of assembling galleries, is now pushing this construction to remodel the entire fan shop. This shop, when completed, will be one of the largest fan shops in the United States, covering 64,235 sq.ft. including 23,873 sq.ft. of assembling galleries. While this extension is in progress production continues without interruption, and when it is completed all fan construction will be accomplished with a minimum of handling.

National Lamp Holds School in Illuminating Engineering

Representatives of twenty-three jobbers' organizations attended the illuminating engineering school held at Nela Park, Cleveland, under the direction of the National Lamp Works of the General Electric Company, June 6 to 10. A total of fifty-five men, each actively engaged in the sale of lighting, attended the "short course" in illuminating engineering. Walter Sturrock, engineering department, National Lamp Works, was director of the school.

Fourteen speakers from the national organization gave nineteen talks, each talk taking up one particular phase of the general subject of lighting, covering both the engineering and sales sides. This class work was supplemented by several inspection trips, one to the Electrical League of Cleveland, where the league's lighting demonstration was given; one to the league's modern electrical home, one through the factories and engineering buildings at Nela Park, and one to a Cleveland factory that had requested recommendations for a new lighting layout.

At this factory the "students" obtained the necessary data and later in the school made the actual lighting layout under the supervision of the National's engineers. Prizes were awarded for excellency in this particular design work.

The Illuminating Engineering School was all business. "We came for information and we got it. It was worth many times its cost," an executive of a jobbers' organization that sent twenty-two representatives to the school declared.

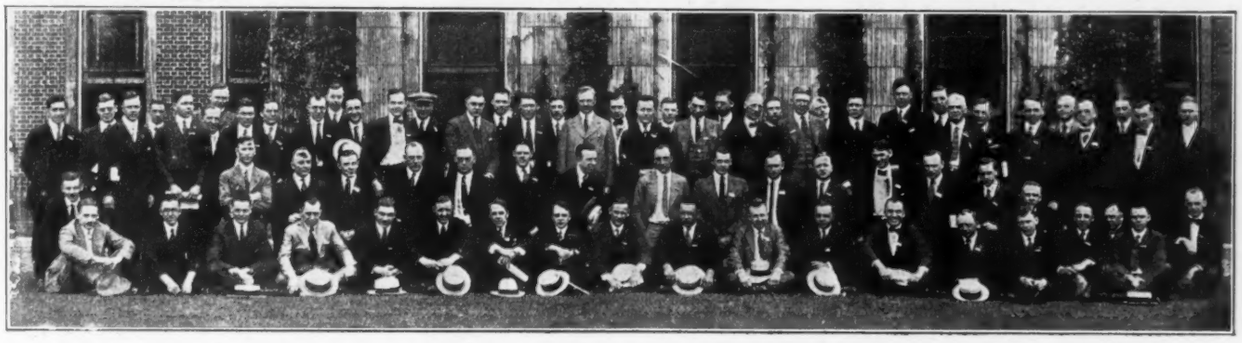
Pettingell-Andrews Takes Axcess Lighting Equipment Agency

The Sampson Axcess Lighting Company, Lynn, Mass., has appointed the Pettingell-Andrews Company, Boston, distributer for the equipment which it manufactures. The Pettingell-Andrews Company will market this apparatus through its industrial lighting department, in charge of Milton D. Riley, illuminating engineer.

Radio Section A. M. E. S. Designates and Elects Committees

At the summer meetings of the various sections of the Associated Manufacturers of Electrical Supplies, held in New London, Conn., last week the newly formed Radio Apparatus Section held its second meeting since its formation. D. R. W. Murdock of the Wm. J. Murdock Company had previously been made chairman of the section. The following committees were designated by name and their chairmen chosen: Executive committee; committee on the advancement of the art, L. G. Pacent of Pacent Electric Company, chairman; receiving sets and associated equipment, M. C. Rypinski of Westinghouse Electric & Manufacturing Company, chairman; transmitting sets and associated equipment, C. F. Cairns of Acme Apparatus Company, chairman; aural receiving devices and accessories, D. R. W. Murdock, chairman.

The section held two sessions and took up several questions tending to elevate the plane of manufacture of radio apparatus out of the amateur class to that of a high-class industry. Publicity and advertising also were discussed. It was decided to have a booth in charge of the section at a radio exhibit and convention to be given by the Ninth Radio District in Chicago in August.



TWENTY-THREE JOBBERS REPRESENTED IN SCHOOL FORMED TO TRAIN SALESMEN IN GENERAL SUBJECT OF ILLUMINATION

The Battery Service Company, Muskogee, Okla., recently incorporated, contemplates the construction of a one-story plant, 110 ft. x 170 ft., to cost about $30,000. J. H. Schmidt is president and manager.

The Peerless Light Company, Peerless Building, 663 West Washington Boulevard, Chicago, has established a Pacific Coast branch in San Francisco under the name of the Peerless Light Company of California at 149-152 Second Street. Joseph H. Reiss is manager.

The Chicago Lighting Fixture Company during the week of June 25 formally opened its remodeled showrooms at 28 West Lake Street, Chicago. There was on display there a new line of lighting fixtures made from designs prepared by the company's own organization. Special designs for office buildings, stores, bungalows, homes and apartmeent buildings were exhibited.

Foreign Trade Notes

LARGE HYDRO-ELECTRIC PROJECT STARTED IN ITALY.—Word has been received by Rodolfo Bolla, American representative of the Banco di Roma, that construction work has started on the great dams of the hydro-electric power development on the Sila River in southwestern Italy. The present plans provide for five artificial lakes and three waterfalls. It is estimated that a total of 300,000 hp. will be developed at the beginning, which will furnish sufficient power for industrial and other requirements of the surrounding country, as well as the electrification of the local railways. On completion of the hydro-electric project power sufficient to supply the eastern coast of Sicily will be developed.

S. N. CLARKSON, formerly on the editorial staff of the ELECTRICAL WORLD and at present practicing as a consulting engineer in the Star Building, St. Louis, has been appointed American representative of Hay & Vickerman, Wellington, N. Z., to select turbines and other electrical equipment for a paper mill in New Zealand. Exact details of the work have not been announced as yet, but it is estimated that the cost of the electrical equipment will be between $50,000 and $75,000.

POSSIBLE HYDRO-ELECTRIC PROJECT IN NIGERIA, AFRICA.—The Keffi Consolidated Tin Company, which operates tin mines in Nigeria, Africa, according to the *Electrical Times*, is considering the use of electricity to operate its properties. The company has no intenion of using its own capital resources in an undertaking of this character, but negotiations are pending with a concern which has gone a long way in developing hydro-electric power. It is proposed to submit to the shareholders a scheme to organize a power company to which the shareholders individually would be able to subscribe.

THE NETHERLANDS CHAMBER OF COMMERCE, 44 Beaver Street, New York City, announces that the time is nearly up to receive applications for participation in the fair which will be held at Utrecht, Holland, Sept. 6 to 16, 1921. The chamber believes that the present time is not one that can be allowed to slip by without resorting to every means possible for extending the American market in Holland.

FRENCH THOMSON-HOUSTON 1920 BUSINESS.—Gross receipts for the year 1920 of the Thomson-Houston Company of France have been reported as 33,850,420 francs, while the gross receipts for 1919 amounted to 24,760,680 francs. Net profit in 1920 amounted to 22,900,070 francs as compared with 15,685,320 francs the year previous. While the dividend in 1919 was 40 francs it was raised in 1920 to 45 francs.

THE NEWARK TOWN COUNCIL in England has decided to apply to the Electricity Commissioners, says the Guaranty Trust Company, New York City, for the grant of a special order for the generation and distribution of electricity and for the provision and maintenance of the necessary apparatus. The initial capital outlay will be £200,000.

NEW MICA DEPOSIT FOUND IN AUSTRIA.—The Department of Commerce, Vienna, asserts that mica of considerable extent and thickness has been disclosed in the Styrian Alps south of Köflach and elsewhere. The utility of mica in electro-technical industries and the fact that it has not been found in any quantities in other countries of Europe give the Styrian deposit a promise of a good market.

PROPOSED HYDRO-ELECTRIC SCHEMES IN VICTORIA, AUSTRALIA.—According to Sir John Monash, chairman of the Victorian Electricity Commissioners, approximately $1,000,000 worth of electrical machinery will be required in connection with the various hydro-electric schemes now receiving consideration by the State of Victoria. The commission has already been able to formulate outline proposals for the utilization in due course, when the time is appropriate and the market for energy develops, of the hydraulic resources of the Kiewa and Rubicon basins, the Acheron, King, Howqua, Snowy and Womnangatta Rivers and the Goulburn River above the Sugarloaf weir.

JOHNSON & PHILLIPS 1920 REPORT.—At the sixteenth annual general meeting of Johnson & Phillips, Ltd., Charlton, London, held on May 5, the report of the company for the year 1920 showed that the profits for the year, after charging to revenue upward of £23,000 for maintenance of building, plant, etc., amounted to £98,405, which is nearly £10,000 more than in the preceding year. During the year £63,408 was expended on additions to buildings and plants as a consequence of largely increased business. In the same way stock in trade and work in progress are valued at £563,356, or an increase of nearly £100,000 over the previous year. The company's order books at the end of the year were reported to be as full as it was considered safe to permit. Some departments had from eight to ten months' work on hand, including large and important government contracts, so that prospects for the current year may be thought highly satisfactory. Orders are still coming in, which gives warrant for the fullest confidence in the future.

PROPOSED EXTENSION TO ELECTRIC PLANT IN CALCUTTA, INDIA.—Trade Commissioner Batchelder reports that the Calcutta Electric Supply Corporation, Ltd., has applied for an extension of its charter until 1938, with the period of renewal twenty years instead of the existing ten years. It claims that these changes are necessary in order to enable it to raise the 13,000,000 rupees (a rupee is normally worth 32 cents) required to meet the increasing demand for electricity, which is estimated to be 22,000 kw. for 1921 and 33,000 kw. for 1922. It is impossible, it is said, to secure additional capital without changing the present arrangement, which permits the Calcutta municipality to buy the plant in 1928. The proposed improvements include new lines, substations, transformer houses, submarine cables across the river, coal-handling and pumping plants, extensions to existing power houses, with increased boiler capacity and an additional generating plant of 21,000 kw.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A manufacturing company in Greece (No. 35,069) desires to purchase a complete installation of machinery for a twine and rope-making plant, with a capacity of 1,000 kg. daily output, using hydraulic power of 900 hp. to 1,000 hp.

A firm of general merchants in India (No. 35,075) desires to purchase 50, 100, 200, 500 and 1,000-cp. lamps, with 50, 100 and 200-cp. fittings with nipples for ordinary ⅜-in. lamp holders, suitable for hanging, provided with T's with insulators on the top and two-wire leads, with enameled reflectors painted black outside, white inside; 50 and 1,000-cp. globes with hole in the glass for ventilation, all to be arranged so that if so desired insulated T's can be removed so as to take ¼-in. gas pipe instead; insulated suspenders, threaded for ¼-in. gas pipe, with two separate wire leads, with insulators on top, and ¼-in. and ⅜-in. recessed base plates, threaded for gas pipe, with round flange for fixing.

A merchant in Trinidad (No. 35,082) desires to purchase a motor and separate generator for repairing and charging batteries.

A firm in Canada (No. 35,091) desires to purchase electric curling irons.

A mercantile company in Canada (No. 35,094) desires to purchase washing machines.

An engineering firm in British East Africa (No. 35,100) requests catalogs of self-contained lighting sets, centrifugal pumps, electrical accessories, etc.

PROPOSED ALUMINUM PLANT IN INDIA TO BE OPERATED BY ELECTRICITY.—According to C. C. Batchelder, trade commissioner, a plan is under consideration for the construction of a plant on the western coast of India to produce aluminum (about 2,500 tons a year) from bauxite, the plant to be operated by electricity. The plans provide for a plant of about 20,000 kw. capacity, power for which would be secured by the construction of a large reservoir to collect and store the annual rainfall and the flow of a small stream, with a head of about 1,700 ft. Considerable quantities of aluminum are now being imported for the manufacture of cooking and other utensils.

THE ROYAL FORWARDING COMPANY, INC., 24 Stone Street, New York City, advises manufacturers in the United States that it is in a position to secure for them a list of merchants in Reval, Esthonia, and Riga, Latvia, who would be willing to dispose of American merchandise in those countries.

New Apparatus and Publications

BELLS, BUZZERS.—Edwards & Company, Inc., manufacturers of bells, buzzers, annunciators, etc., has issued a new catalog, dated June 1, canceling all previous price lists, bulletins and catalogs.

ARC WELDER.—The Railway Track-Work Company, Philadelphia, has placed on the market a new "Ajax" resistance-type arc welder.

TEMPERATURE CONTROL.—The Fulton Company, Knoxville, Tenn., has issued two folders on its "Sylphon" temperature regulators.

TEMPERATURE REGULATOR CHART.—A "Temperature Regulator Chart, or Engineering Data Sheet," has been copyrighted by the Fulton Company, Knoxville, Tenn., for use in figuring tank regulators.

RIGID CONDUIT.—In the June 15 issue of the *Youngstown* (Ohio) *Sheet and Tube Bulletin* an article appears on the production of the company's rigid conduit and flexible armored conductor.

BALL BEARINGS.—The Fafnir Bearing Company, New Britain, Conn., in its July issue of the *The Dragon*, discusses the use of ball bearings on fractional-horsepower motors in domestic use.

REINFORCED CORD.—The Rome Wire Company, Rome, N. Y., has developed a "superservice" cord for portable electric tools, etc.

REINFORCED CABLE.—"Spiralweave" cables for portable light and power service, mining, etc., have been put on the market by the Hazard Manufacturing Company, Wilkes-Barre, Pa.

TIME STUDY WATCH.—A new instrument termed the "duration time study watch," designed to handle the timing, analysis and observation of from one to ten operations up to and including five minutes of duration, has been brought out by the Mortimer J. Silberberg Company, People's Gas Building, Chicago.

ELECTRIC GLUE POT.—"Glue Pot Service" is the title of a pamphlet issued by the Automatic Electric Heater Company, Warren, Pa., covering its electric glue pots.

STOKER COAL CRUSHER.—The Jones automatic coal crusher for use on Jones standard stokers has been put on the market by the Under-Feed Stoker Company of America, 721 Book Building, Detroit, and a descriptive leaflet has been issued.

INSULATION.—The Mica Insulator Company, 68 Church Street, New York City, has developed a flexible oiled cotton tube for withstanding high temperature in electrical machine and instrument winding.

AIR-PURIFYING APPARATUS.—"Carrier Air Washers and Humidifiers" is the title of catalog No. 480, recently issued by the Carrier Air Conditioning Company, Buffalo, covering its air washers, generator coolers and other apparatus.

EXPORT TRADE DIRECTORY.—The *American Exporter*, 370 7th Avenue, New York City, has just published the 1921-22—the seventh—edition of the "Export Trade Directory." There are 1,036 pages in the book, the price of which is $10.

ELECTRIC SERVICE FOR FARMERS.—The Delta-Star Electric Company, Chicago, is distributing special publication, No. 55, devoted to central-station service for farmers.

FIRE PROTECTION.—The Oil Conservation Engineering Company, Wade Building, Cleveland, is distributing a pamphlet describing the 10-gal. "Oceco" chemical engine recently developed by the company. The engine is designed particularly for use in electric power stations, transformer, relay and storage-battery stations.

INSULATING TAPE.—The Diamond Holfast Rubber Company, 33 Auburn Avenue, Atlanta, Ga., is distributing a leaflet covering the "Diamond-Holfast" two-plex insulating tape recently placed on the market.

CONDUIT BENDER.—The Henderson Electric Company, Ampere, N. J., is distributing a pamphlet covering the Henderson "E-Z" stationary conduit bender, recently put on the market.

PRESSURE REGULATOR.—The Fisher Governor Company, Marshalltown, Iowa, has issued Bulletin No. 210 on its series 90 pressure regulators.

New Incorporations

THE UNITED ELECTRIC PRODUCTS COMPANY, New York, N. Y., has been incorporated by A. Rappaport and M. S. Solomon. The company is capitalized at $30,000 and proposes to manufacture electric goods. Dreschler, Orenstein & Leff, 225 Fifth Avenue, represent the company.

THE McLELLAND ELECTRIC BAKE OVEN CORPORATION, 36 South State Street, Chicago, has been incorporated with a capital of $100,000 to manufacture and install electric conveyor ovens and other baking apparatus. The incorporators are Charles E. Weadley, Julius Slora and William McLelland.

THE ABSOLUTE CONTACTOR CORPORATION, 126 Shirland Avenue, South Beloit, Ill., has been incorporated at $100,000 to manufacture electrical and mechanical apparatus, accessories and machinery. Louis M. Phelan, Chicago, is president.

THE CHAPEL ELECTRIC COMPANY, Jackson, Mich., has been incorporated by Ralph D. Chapel, F. Bling and Charles D. Dixon, Jackson. The company is capitalized at $20,000 and proposes to manufacture electrical equipment.

THE AXILROD POWER TRANSMISSION COMPANY, Philadelphia, Pa., has been chartered with a capital of $280,000. The company proposes to manufacture power transmission machinery, gearing, etc., and is represented by F. R. Hansell, Land Title Building.

THE STAMP ELECTRIC HOIST COMPANY, San Francisco, has been incorporated by William T. Burney, C. S. Somers and Horace W. Lash, Monadnock Building. The company is capitalized at $75,000 and proposes to manufacture electrically operated hoisting machinery.

THE SHELBY (MISS.) LIGHT & POWER COMPANY, has been incorporated with a capital of $40,000 by Daniel Bradera and L. B. Wilkinson.

THE DOMESTIC APPLIANCE COMPANY, 315 South Jefferson Avenue, Peoria, Ill., has been incorporated with a capital of $50,000 by E. C. Knecks, M. V. Stagg and R. B. Perry.

ELECTRIC REFRIGERATORS, LTD., Toronto, Ont., has been incorporated by R. L. Kellock, Harold W. Keyes and F. C. Carter. The company is capitalized at $40,000 and proposes to manufacture refrigerators, etc.

THE HOOSIER FARM LIGHT COMPANY, Evansville, Ind., has been incorporated with a capital of $150,000 to manufacture farm-lighting systems. The incorporators are J. Morris, W. A. Koch and Charles F. Dickmann.

THE MASSACHUSETTS RADIO & TELEGRAPH COMPANY, Boston, Mass., has been incorporated with a capital of $20,000 to manufacture radio and other electrical equipment. The officers are: Guy R. Entwistle, president, and Raymond F. Trop, treasurer.

H. J. SHAFFER & COMPANY, INC., New York, N. Y., has been incorporated by H. J. Shaffer, W. L. Coston and W. C. G. Wahle. The company is capitalized at $35,000 and purposes to manufacture motors, etc. Dunn & Daley, 261 Broadway, represent the company.

WALTER KNAPP & COMPANY, New York, N. Y., has been incorporated by Walter Knapp, J. J. Rathgeb, Jr. and F. H. Sander. The company is capitalized at $10,000 and proposes to manufacture electrical devices and systems.

THE ELECTRIC SAFETY EQUIPMENT COMPANY, Angola, Ind., has been incorporated by J. B. Fitch, H. G. MacLellan and E. A. Skinner, all of Angola. The company is capitalized at $25,000 and purposes to manufacture electrical equipment and accessories.

THE LIGHTING PRODUCTS CORPORATION, Wauwatosa, Wis., has been incorporated by Clarence Ullman, W. F. Zack and J. J. Meyer, all of Wauwatosa. The company is capitalized at $40,000 and proposes to manufacture electric lighting fixtures, line materials, etc.

THE PAUL E. FLOTRON COMPANY, Philadelphia, Pa., has been incorporated with a capital of $50,000 to manufacture ice-making and refrigerating machinery. Paul E. Flotron, 207 North Thirty-fifth Street, is treasurer.

THE STANTON (KY.) UTILITIES COMPANY has been incorporated with a capital of $10,000 by Jesse Swangon and James Proffitt.

Record of Electrical Patents

Notes on United States Patents

(Issued June 14, 1921)

1,381,772. ELECTRICAL CONNECTOR; Flake M. Wakefield, Anniston, Ala. App. filed May 1, 1920. Multiple connection embodying aligned sockets.

1,381,785. SECONDARY WINDING FOR INDUCTION MOTORS; Henry Bewlay, Mansfield, Ohio. App. filed May 18, 1918. High-resistance secondary without joints.

1,381,807. TROLLEY HEAD; Hencel Daffron and Clyde C. Pullem, Detroit, Mich. App. filed Feb. 5, 1921. Accidental jumping from wire prevented.

1,381,827. WIRELESS PHONOGRAPH FOR HOSPITALS; Earl C. Hanson, Los Angeles, Cal. App. filed June 3, 1918. For reproducing music.

1,381,838. INSULATOR SUPPORT; Berry B. Jackson, Mudlock, Ky. App. filed March 30, 1920. Cross-arm easily fastened on pole.

1,381,852. AUTOMATIC CAR AND ELECTRIC COUPLING AND REVERSING SWITCH; Charles H. Tomlinson, Mansfield, Ohio. App. filed June 7, 1916. Simple and improved.

1,381,875. TROLLEY RETRIEVER; George E. Harpham, Los Angeles, Cal. App. filed May 16, 1918.

1,381,882. ELECTROLYTIC APPARATUS AND PROCESS; Matthew M. Merritt, South Middleton, Mass. App. filed Nov. 2, 1917. Manufacture of sheet copper.

1,381,883. ELECTROLYTIC PROCESS, PRODUCT AND APPARATUS; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Manufacture of wire.

(Issued June 21, 1921)

1,381,903. TELEPHONE DESK SET; Peter C. Burns, Chicago, Ill. App. filed June 16, 1920. Improved rubber cushion.

1,381,959. STORAGE BATTERY; Arthur J. Baracree, Chicago, Ill. App. filed March 24, 1919. Supporting means for battery plates.

1,381,968. ELECTRICAL MEASURING APPARATUS; John L. Clarke, Montreal, Canada. App. filed Feb. 10, 1920. To determine transmission losses.

1,381,985. ELECTRIC MOTOR; Alfred C. Gilbert, New Haven, Conn. App. filed Nov. 26, 1917. Small and portable for home use.

1,382,012. LINE-SWITCH SYSTEM; Winfred T. Powell, Rochester, N. Y. App. filed May 14, 1919. Automatic telephone.

1,382,099. JUMP-SPARK ELECTRIC GAS-LIGHTER; Alvin J. D. Lenz, Evanston, Ill. App. filed Oct. 21, 1920.

1,382,101. ELECTRICALLY HEATED ARTICLE TO AVOID DAMAGE THROUGH OVERHEATING; George H. Lofts, Hobart, Tasmania, Australia. App. filed April 15, 1920. Pin melts at high temperature.

1,382,129. STORAGE-BATTERY CONNECTOR; Lytton J. Shields, St. Paul, Minn. App. filed Aug. 8, 1918. Connects cells together.

1,382,156. APPARATUS FOR HEATING LIQUIDS; Luis G. Abogado, Mexico, Mex. App. filed May 12, 1919. Liquid flows in very thin film.

1,382,157. PROCESS OF HEATING LIQUIDS; Luis G. Abogado, Mexico, Mex. App. filed May 12, 1919. Heats thin spirally moving film of liquid.

1,382,158. APPARATUS FOR STERILIZING LIQUIDS; Luis G. Abogado, Mexico, Mex. App. filed June 4, 1919. By electric current.

1,382,159. PROCESS FOR STERILIZING LIQUIDS; Luis G. Abogado, Mexico, Mex. App. filed June 4, 1919. By electric current.

1,382,177. RADIO-SIGNALING APPARATUS; William Dubilier and Philip Dubilier, New York, N. Y. App. filed July 10, 1916. For producing high-frequency oscillations.

1,382,206. TRANSMITTING APPARATUS; David G. McCaa, Lancaster, Pa. App. filed Jan. 19, 1920. Transmitting high-frequency energy.

1,382,234. DEHYDRATOR FOR PETROLEUM OILS; Henry R. Quinby, Maricopa, Cal. App. filed Feb. 25, 1920.

1,382,257. VARIABLE-SPEED CONSTANT VOLTAGE GENERATOR; William A. Turbayne, Niagara Falls, N. Y. App. filed Nov. 6, 1916. Inherent regulation.

1,382,270. STORAGE BATTERY; Alvin Bugbee, Trenton, N. J. App. filed April 21, 1920. Container of acid-resisting material.

1,382,440. YIELDING TERMINAL CAP FOR DRY-BATTERY CELLS; Adolph C. Recker, Oakville, Conn. App. filed Feb. 28, 1921. Prevents lamp breakage.

1,382,483. ELECTRIC LINE-WIRE INSULATOR; John G. Decker, Stroudsburg, Pa. App. filed May 24, 1918. Telegraph, telephone and trolley wires.

1,382,494. PURIFICATION OF ZINC SOLUTIONS; Samuel Field, London, England. App. filed Dec. 17, 1920.

1,382,510. WIRING-CONDUIT CAP; Frederick I. Johnson, Warren, R. I. App. filed July 18, 1919. Elbow-shaped body with rotatable coupling.

1,382,547. COMMUTATOR CLEANER; Matthew W. Roberts, Lumberton, Miss. App. filed March 28, 1921. For electric railway signaling motors.

1,382,590. SUBMARINE WIRELESS SYSTEM; William G. Zeigler, Chicago, Ill. App. filed Jan. 3, 1920. Wireless transmitted through water.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME.—The Cumberland County Power Company has disposed of an issue of bonds, the proceeds to be used for improvement, etc.

SEARSBURG, VT.—Announcement has been made of further details in connection with the large hydro-electric project of the New England Power Company, Worcester, Mass., at Searsburg. The plans provide for the development of an additional 40,000 hp. on the Deerfield River and the construction of a power plant at Searsburg and also at Davis Bridge, below Searsburg, the latter to develop 30,000 hp. The total cost of the project is estimated at $6,000,000.

ABINGTON, MASS.—The Massachusetts Department of Public Utilities has approved an increase of $56,100 in the capital stock of the Electric Light & Power Company of Abington and Rockland, to meet the cost of plant extensions.

PROVIDENCE, R. I.—Bids have been rejected by the Narragansett Electric Lighting Company for a proposed new power house and machine and service building, two stories, 114 ft. x 172 ft., estimated to cost about $200,000. The project will be held in abeyance. Jenks & Ballou, Grosvenor Building, are architects.

NEW BRITAIN, CONN.—The Hart & Colley Manufacturing Company, manufacturer of steel specialties, plans to build a new one-story power house, 39 ft. x 50 ft., on Corbin Avenue.

Middle Atlantic States

ENDICOTT, N. Y.—The Binghamton Railway Company, we are informed, is not considering the construction of a power house at Endicott as reported in these columns in the June 18 issue. The company is about to connect up the high-tension line in Pennsylvania with its present Endicott substation. It is not in the market for supplies of any kind. W. G. Phelps is receiver.

GENESEE, N. Y.—The Mount Morris Illuminating Company is considering extension to its system to Genesee to furnish electricity here.

NEW YORK, N. Y.—The New York Edison Company, it is reported, will take bids at once for the foundation work for its proposed new two-story substation, 25 ft. x 40 ft., to be built at 10-12 Elizabeth

Street. Plans are being prepared for the superstructure and equipment installation. William Whitehill, 12 Elm Street, is engineer.

NIAGARA FALLS, N. Y.—Negotiations are under way between the Niagara Falls Gas & Electric Company and the city of Niagara Falls for the purchase of the former's local power plant.

SANBORN, N. Y.—The Cambria Power Company, recently incorporated with a capital of $100,000, proposes to establish and operate a local electric light plant. G. G. Mattern, Kenmore, is interested in the company.

NEWARK, N. J.—Arrangements are being made with the Public Service Electric Company for the installation of a new lighting system on various streets, to cost about $7,500. The plans provide for lamps of 1,500 cp. on Broad Street and 1,000-cp. lamps on Market Street, Clinton, Springfield and South Orange Avenues, and 600-cp. lamps to replace the 400-cp. lamps now in use in the outlying sections.

ALLENTOWN, PA.—Resolutions have been adopted by the City Council providing for the installation of additional lamps on Rye and Lewis Streets and other thoroughfares in the city.

CHARLEROI, PA.—Steps have been taken by the Chamber of Commerce to secure the installation of a new ornamental lighting system in the business district.

GLEN ROCK, PA.—The Enterprise Furniture Company is having plans prepared by W. E. S. Dyer, engineer, Land Title Bldg., Philadelphia, for the construction of a power plant at its works.

HARMONY JUNCTION, PA.—Contracts between the Harmony Electric Company and the Boroughs of Enoch Valley and Connoquenessing have been approved by the Public Service Commission to construct and maintain a lighting system in those places.

PHILADELPHIA, PA.—Plans are being prepared by the W. H. & E. A. Margerison & Company, Jasper and Huntingdon Streets, for the construction of a power house at their towel factory.

FROSTBURG, MD.—An ordinance has been passed by the City Council providing for the installation of an ornamental lighting system on Main Street from Bowery to Water Street. The plans provide for thirty-two steel standards carrying two lamps each.

FARNHURST, DEL.—Plans are being prepared for the construction of a one-story power house at the Delaware State Hospital at Farnhurst.

KINGWOOD, W. VA.—The construction of an electric power plant in the vicinity of Kingwood for commercial service between Rowlesburg and Cumberland, Md., is under consideration. The cost is estimated at $3,000,000. Col. C. C. Pierce, Kingwood, is interested.

PRINCETON, W. VA.—Plans are under way by the Micajah Pocahontas Coal Company, Princeton, recently organized with a capital of $300,000, for the establishment of a plant including a power house, equipped with rotary converter, at its properties at Micajah. Coal cleaning and screening equipment, etc., will also be required. L. R. Taylor is president.

PORTSMOUTH, VA.—The City Council has requested the City Manager to submit an early report on the advisability of establishing a municipal lighting plant in Portsmouth.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the army, Washington, D. C., until July 16, circular PR 6930-20CP, for 7,000 porcelain insulators.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to make improvements to the power plant at Iona Island. Applications accompanied by a deposit of $10 may now be filed for plans and specifications (4215), and necessary data for bidding will be forwarded in the near future. All communications should be addressed to the Chief of the Bureau of Yards and Docks.

North Central States

LANSING, MICH.—D. C. Milburn, efficiency engineer for the State Administrative Board, has submitted report recommending improvements to the power and heating plants at the State institutions.

TRAVERSE CITY, MICH.—Bids will be received by O. C. Moffatt, city clerk, until July 13, for furnishing certain material and labor for the construction of a hydro-electric plant about 13 miles from Traverse City. The plans include a dam 1,600 ft. long. Plans and specifications can be obtained from the Fargo Engineering Company, Jackson, upon a deposit of $10.

WAYLAND, MICH.—An option has been secured on the local electric light plant by Clarence L. Miller and Walter F. Wolfe of Otsego. It is planned to purchase power from the Consumers' Power Company at Monteith Junction for distribution in Wayland, Martin, Hopkins and adjacent vicinity. Bids are being asked on line material.

CLEVELAND, OHIO — The Cleveland Electric Illuminating Company is having plans prepared for the construction of a one-story power substation on Cedar and Lee Roads, to cost about $40,000. A. Gallagher, Illuminating Building, is architect.

HICKMAN, KY. — Henry Ford, Detroit, Mich., it is reported, is considering the construction of a dam on the Mississippi River between Dorena and Hickman for hydro-electric development.

BREWERSVILLE, IND.—The Hoosier Electric Light, Heat & Power Company, recently incorporated with a capital of $20,000, it is reported, plans to harness streams in Jennings County for hydro-electric development to supply neighboring towns includng Westport and North Vernon.

LAFAYETTE, IND.—Plans are being prepared for the construction of a new power plant and one-story automobile service and repair works at St. Elizabeth's Hospital, Fourteenth and Hartford Streets. D. X. Murphy, Louisville Trust Building, Louisville, Ky., is architect.

MAXWELL, IND.—The local substation of the Union Traction Company was recently damaged by fire.

DIXON, ILL.—The Northern Illinois Utilities Company plans to erect a transmission line to serve the rural territory southeast of Franklin Grove near Dixon.

EAST, ST. LOUIS, ILL.—A movement has been started for the installation of street lamps in Collinsville Avenue between Broadway and Illinois Avenue. The plans provide for fifty-four posts, to cost about $11,000.

WILLMAR, MINN.—Improvements are contemplated to the municipal electric light and power plant to cost about $45,000.

REMSEN, IOWA.—Bonds to the amount of $60,000 have been voted for the construction of a municipal light and power plant.

COLUMBIA, MO.—Plans are being prepared by Prof. G. D. Newton of the School of Engineering, University of Missouri, for the construction of a power house and heating plant at the university.

LINN CREEK, MO.—The construction of a power plant and dam on the Niangua River is under consideration. J. B. Quigley, Lebanon, is interested.

ST. LOUIS, MO.—The Missouri Gas & Electric Company, St. Louis, has applied to the State Public Service Commission for permission to erect an electric transmission line between Liberty and Lexington, passing through Missouri City, Orrick, Camden, Richmond and Henriette.

QUENEMO, KAN.—Arrangements are being made by the city officials of Quenemo to erect an electric transmission line to connect with the plant at Ottawa to secure energy for the municipal electric system, to cost about $10,000. Electricity for operating the local system was formerly obtained from the Lyndon plant, which was recently destroyed by fire. Lyndon will be served from Osage City.

Southern States

CHAPEL HILL, N. C.—Extensions to the lighting, water and sewerage systems at the University of North Carolina, to cost about $100,000, are under consideration. T. C. Atwood, Chapel Hill, is engineer.

DUNN, N. C.—An agreement has been reached whereby the Carolina Power & Light Company will purchase and operate the municipal light and power plant, subject to the approval of the voters. The company also proposes to purchase the transmission line between Selma and Benson, owned by the town of Benson, and extend the line from the latter town to Dunn, rebuilding a portion of the local lines. The purchase of the line and improvements in connection with same are estimated to cost about $100,000.

OTEEN, N. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 20, for the installation of a fire-alarm system in the public health service hospital at Oteen.

JEFFERSONVILLE, GA.—The local electric light station was recently destroyed by fire, leaving the town without electric service. Work will begin in rebuilding the plant as soon as possible.

ROCK MART, GA.—At an election to be held July 12 the proposal to issue $15,000 in electric light and power bonds will be submitted to the voters.

BRONSON, FLA.—The Bronson Manufacturing Company is considering increasing its capital from $15,000 to $25,000, the proceeds to be used for the installation of an electric light, ice and cold-storage plant for Bronson. B. B. Stokes is secretary.

GREEN COVE SPRINGS, FLA.—The question of submitting to the voters a proposal to issue $150,000 in bonds for improvements and additions to the electric light and power plant, etc., is under consideration.

RUSSELLVILLE, ARK.—Plans are under consideration for the installation of a lighting system on Oak, Main and River Streets from the railroad to David Street, and on Main Street from Oak Street to Mary Street. Electrical energy will be furnished by the Arkansas Light & Power Company.

KERRVILLE, TEX.—Plans are under consideration for the construction of a refrigerating and ice-making plant at the proposed new sanitarium at Kerrville to be erected by the American Legion Memorial, Austin. The plans provide for the construction of a power plant. The cost is estimated at about $1,200,000. Phelps & Dawes, 715 Gunter Building, San Antonio, are architects.

MOULTON, TEX.—F. W. Wise, Victoria, is considering the establishment of an electric light and ice plant in Moulton.

Pacific and Mountain States

RIVERSIDE, CAL.—The installation of ornamental lamps on several streets and in Fairmount Park is under consideration.

DUCHESNE, UTAH.—A preliminary permit has been issued to the Great Basin Power Company, Salt Lake City, for a 4,000-hp. hydro-electric development on the West and North Forks of the Duchesne River. The plans provide for the construction of a storage dam on the North Fork and diversion dams on the West Fork and on Wolf Creek, pipe lines to run from the reservoir and the two diversion dams to a common forebay from which a penstock to the power house will be built, and conduits totaling 70,000 ft. in length. The company also proposes the erection of four transmission lines, one to Salt Lake City and the others serving communities within a radius of 60 miles from the power site.

GUERNSEY, WYO.—The next project to be undertaken by the United States Reclamation Service in this section of the country will be the Guernsey dam. The proposed dam will supply water for irrigation purposes, covering an area that has not yet been covered, and in addition will supply power to generate electricity to be distributed throughout the entire North Platte Valley, and also to the iron mines of Sunrise, Wyo., and to large coal and oil fields.

Canada

PEACE RIVER, ALTA.—The construction of a municipal electric lighting plant and system is under consideration.

ERIE BEACH, ONT.—The Hydro-Electric Power Commission of Ontario has prepared estimate of cost of the installation of hydro-electric service at Erie Beach.

LONDON, ONT.—Bids addressed to the chairman and members of No. 2 committee will be received at the office of the city clerk until July 21 for the installation of four sewage pumps and complete electrical equipment. Specification and form of bid may be obtained at the office of H. A. Brazier, city engineer.

SARNIA, ONT.—Extension of the Sarnia Hydro-Electric System in the beach district is under consideration.